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# FIRE CONTROL NOTES

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A PERIODICAL DEVOTED
TO THE TECHNIQUE OF
FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 12 Number 1

# FIRE CONTROL NOTES

## A Quarterly Periodical Devoted to the

## TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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Forest Service, Washington, D. C.

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# 1949 FIRES AND TRENDS OF FIRE OCCURRENCE IN THE NORTHEAST

A. W. Lindenmuth, Jr.

*Forester, Fire Research, Southeastern Forest Experiment Station*

In 1949, 10,858 fires were reported to have burned on State-protected and national forest land in the Northeast.[1] This was a 42-percent increase over 1948. Was the increase caused by a larger number of fire starters, a letdown in fire-prevention efforts, a more severe fire season, or a combination of all three? An analysis of fire-danger measurements and fire records provides some good clues.

We know that about 99 percent of the fires starting in this region are caused by man. Hence, the number of fires depends chiefly upon two factors, risk and flammability. Risk, or the probability of someone or something causing a fire, can be controlled by fire-prevention efforts but cannot be measured directly. Flammability, on the other hand, cannot be controlled but can be measured quite accurately. Burning index in the Northeast is a measure of flammability.

In order to separate the effects of risk and flammability (burning index), a method of rating the severity of fire seasons, reported in a previous article,[2] is used. Briefly, the number of expected fires is calculated from the cumulated burning indexes as reported from the fire-danger stations, assuming for purposes of the calculation that an unchanging risk prevails. Then the expected and the actual number of fires are plotted for a number of years.

To show this, data from all northeastern national forests and States, excepting Delaware (for which information is not available), are graphed in figure 1. It is evident that both the number of actual and expected fires took a sharp upswing in 1949. The trends are not exactly the same but the amount of divergence is small—1949 ratio 1.03, 1948 ratio 0.95. For the region as a whole, the risk was almost the same in 1949 as it was in 1948, and it can therefore be concluded that the difference in the number of fires between the years was caused by weather conditions.

In graph B, figure 1, the ratios plotted for the past 7 years indicate a downward trend, even though there are humps and dips from year to year and there is a slight upswing in 1949. Statistically, the odds are about 10 to 1 that this is a real trend. While these odds are relatively small, they are supported by the fact that fire prevention efforts are being intensified each year. It is reasonable to suppose that in this region the annual expenditure of, roughly, 3 million dollars for prevention is accomplishing something.

---

[1] Only fires that occurred on days when fire-danger measurements were made are included.

[2] Lindenmuth, A. W., Jr., *and* Keetch, J. J. a new measure of the severity of fire seasons. U. S. Forest Serv. Fire Control Notes 11(1): 15-19, illus.

We can't assume that the over-all downward trend necessarily applies to individual States or national forests. This is evident from the data in table 1.

One major comparison that can be made within the region is between States and national forests. The State job is to prevent fires on privately owned lands on which the protection agency has relatively little control over the fire risk. On the other hand, the U. S. Forest Service is chiefly concerned with reducing the number of fires on Federally owned lands, where it has considerable control over risk (timber sale agreements, campfire and hunting permits, etc.).

Despite this difference, we find that the ratios for the two groups are about the same during 1949 (1.03 for the States and 0.90 for the national forests) as, in fact, they have been for the last few years. This similarity

TABLE 1.—*Fire occurrence and season ratings, by national forests and States, Northeastern Region,* 1949

| Unit | Fires | | Ratio of actual to expected fires |
|---|---|---|---|
| | Actual[1] | Expected | |
| National Forest: | *Number* | *Number* | |
| Allegheny | 23 | 21 | 1.10 |
| Cumberland | 72 | 88 | 0.82 |
| George Washington | 39 | 41 | 0.95 |
| Green Mountain | 4 | 2 | 2.00 |
| Jefferson | 37 | 38 | 0.97 |
| Monongahela | 25 | 36 | 0.69 |
| White Mountain | 7 | 4 | 1.75 |
| Total or ratio | 207 | 230 | 0.90 |
| State: | | | |
| Connecticut | 435 | 933 | 0.47 |
| Kentucky (Kentenia-Redbird Dist.) | 30 | 22 | 1.36 |
| Maine | 677 | 380 | 1.78 |
| Maryland | 381 | 622 | 0.61 |
| Massachusetts | 1,616 | 1,296 | 1.25 |
| New Hampshire | 527 | 377 | 1.40 |
| New Jersey | 1,465 | 1,336 | 1.10 |
| New York: | | | |
| Adirondacks District | 424 | 237 | 1.79 |
| Long Island District | 150 | 251 | 0.60 |
| Pennsylvania | 1,495 | 1,665 | 0.90 |
| Rhode Island | 303 | 204 | 1.49 |
| Vermont | 173 | 107 | 1.62 |
| Virginia | 1,601 | 1,787 | 0.90 |
| West Virginia (30 counties) | 1,374 | 1,110 | 1.24 |
| Total or ratio | 10,651 | 10,327 | 1.03 |
| Region total or ratio | 10,858 | 10,557 | 1.03 |

[1] Only fires that occurred on days when fire-danger measurements were made are included.

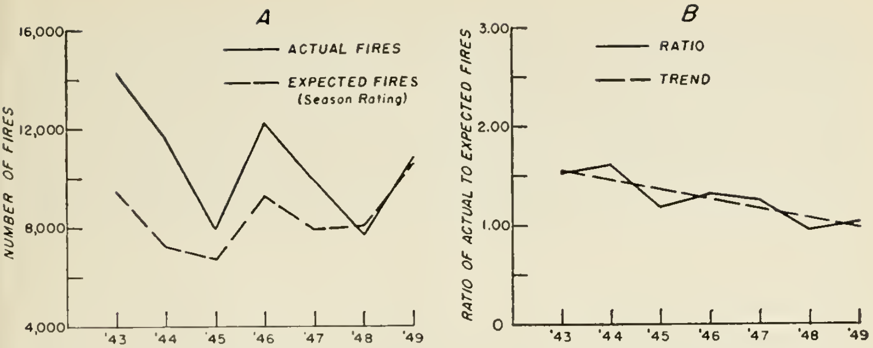

FIGURE 1.—*A*, In the northeastern region the 42-percent increase in number of fires in 1949 over 1948 was due almost entirely to a similar increase in the severity of the fire season. *B*, Irrespective of the slight upswing in 1949, the over-all trend of the ratio of fire occurrence in the Northeast is downward.

of accomplishment is shown graphically in figure 2. Both groups have been successful in reducing the number of fires and one group has done about as well as the other, since the downward trend for each group has about the same slope. The national-forest data are the more erratic because the number of fires occurring in any year is relatively small; for some forests a few fires more or less can markedly affect the ratio.

Of more importance, perhaps, are the trends indicating either increases or notable decreases in the fire-occurrence ratio. Increases point to a greater risk not effectively controlled by prevention efforts. Notable decreases in the number of fires mean that the risk is less either because of fewer fire-starting agents or because the activity of the causal agencies has been curbed by an effective prevention program. A knowledge of these trends should enable administrators to search for a change in the risk pattern, or—in the case of improvement—to evaluate and distinguish the measures that are paying off.

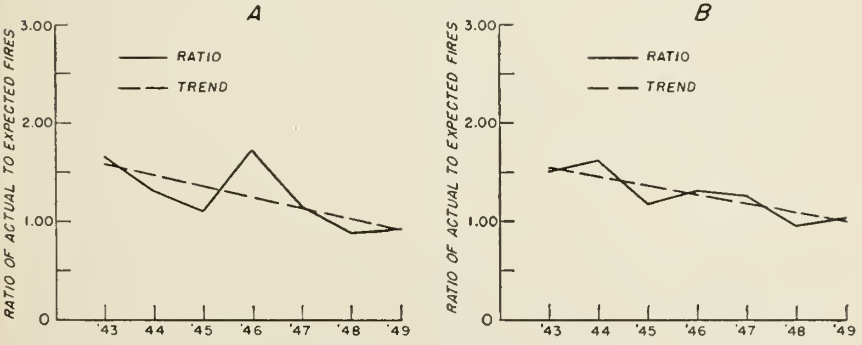

FIGURE 2.—*A*, Records from the national forests in the northeastern region show an over-all decrease in the fire-occurrence ratio within the national forests. *B*, Records from all States in the Northeast, except Delaware, show that the ratio of fire occurrence is decreasing on private lands to about the same degree as within the national forests.

Increases in fire-occurrence ratio seem to be more prevalent in the northern part of the region, as attested by the relatively high ratios (table 1) associated with many of the units from the Adirondacks eastward. Particularly among the northernmost units, Maine, New Hampshire, Vermont, and the Green Mountain and White Mountain National Forests, the number of fires has been at a high level for several years and the over-all trend is upward. This situation is evident in figure 3. Except for the easy years of 1943 and 1945, the number of fires has been much greater in proportion to the cumulative burning index than expected. However, there is evidence that the upward trend, attributable chiefly to the unusually large number of fires during 1944, 1946, and 1947, has been reversed during 1948 and 1949. It is too soon to be certain, but the reduction in the ratio of actual to expected number of fires was common in 1949 to all States in New England, except Rhode Island. Maine, which formerly had the highest ratio in New England, made the greatest reduction—from 2.58 in 1948 to 1.78 in 1949. All these changes occurred despite an increase in the severity of burning conditions in northern New England.

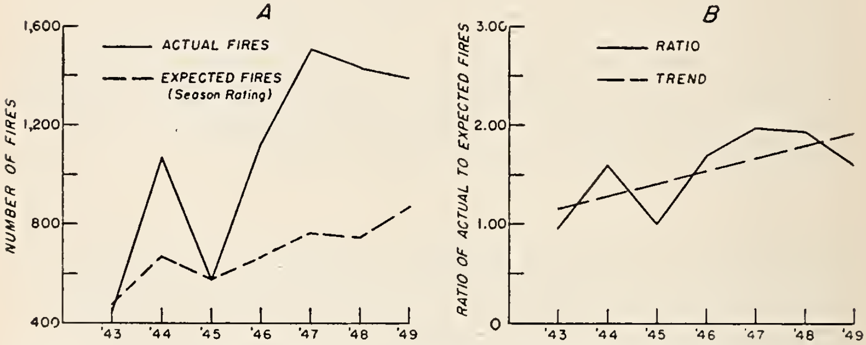

Figure 3.—*A*, The number of fires occurring within the northernmost group of States and national forests of the northeastern region has been high for several years. *B*, Because of this large number of fires, the over-all trend of the ratio of fire occurrence is upward in this section of the region.

A notable decrease in fire-occurrence ratio took place in Connecticut. This outstanding record is closely followed by that of Maryland and the Monongahela National Forest, in that order. In Connecticut the ratio of actual to expected number of fires decreased steadily year by year from 1943 through 1949 (figure 4). The decreases have been so uniform and so sustained that they are almost certainly the result of a planned program—the odds being about 200 to 1 that this did not happen by chance. Had the downward trend been caused by a smaller number of fire-starting agents each year, the results would not have been so uniform. At any rate, there is no evidence to indicate that the number of picnickers, hunters, debris burners, etc., decreased in this State while they increased in nearby States. Fire-prevention measures apparently are responsible for changing the habits of the persons who have been causing the fires.

The year 1949, then, in the Northeast was a bad year when gaged solely by the number of fires that occurred. But valid conclusions cannot

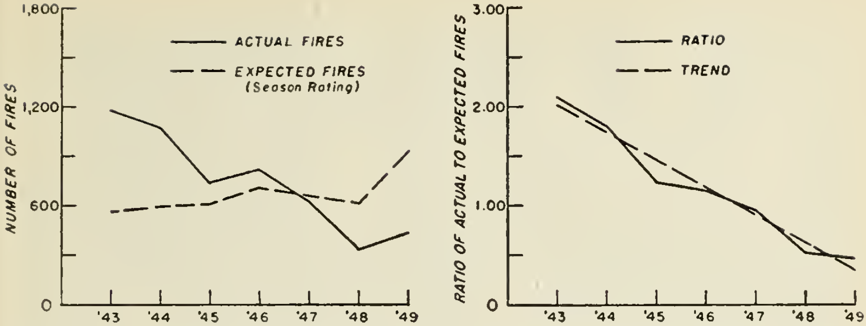

FIGURE 4.—Accomplishments in Connecticut are an example of a notable reduction in the ratio of fire occurrence.

be based on that fact alone. The cumulative burning index for the year indicates that more fires could have been expected during 1949 than in any other year since danger measurements have been made. Region-wide, the evidence indicates that the fire-control organizations handled a bad year without losing ground—with gains just about balancing the losses. When allowance is made for the year's weather, it is clear that the trend toward increased efficiency is continuing.

## Heating and Ignition of Small Wood Cylinders

This is the title of an article by Wallace L. Fons published in the October 1950 issue of "Industrial and Engineering Chemistry." A small supply of reprints has been requested for distribution to those interested in the technical details. The work reported in the paper is a part of the more fundamental fire research being carried out at the California Forest and Range Experiment Station at Berkeley.

Although the paper may seem highly technical to the average fire man, it may have considerable significance to future improvements in fire fighting methods. The paper describes the use of an electric furnace with thermocouples and photoelectric potentiometers to measure and record the surface and interior temperatures of wood cylinders up to the time they ignite.

From the tests made, it was found that surface ignition temperature of 650° F. was most significant for twigs and branch wood. This was found to be the minimum temperature at which flames would appear when rapid heating took place. But if part of the material was first reduced to charcoal, it would glow at temperatures as low as 450°. Charred materials thus ignite easier than most other fuels. In fire fighting, fuels must, for the same reason, be cooled to temperatures below 450° to be certain the fire will not rekindle.

The tests demonstrated that ignition slowed up significantly as size of the stick increased even in the diameter range of ⅛ to ⅜ inch used, so long as the temperature to which the sticks were exposed was betwen 800° and 1000° F. At 900° the range in time was from 20 to 44 seconds. At temperatures of 1300° or more, all sizes used burst into flame simultaneously in less than 5 seconds. This is highly significant to fire behavior and illustrates the importance of the temperature and character of the flame front that builds up. These results were at very low moisture contents. Moisture in the wood also slowed up ignition decisively. This effect was more pronounced than would be accounted for by specific heat of the water alone.

The temperature of the wood itself in the range of 50° to 150° F. had relatively little effect on the rate of ignition in the furnace tests.—A. A. BROWN, *Washington Office, U. S., Forest Service.*

# TEXAS CENTRALIZED RADIO DISPATCHING SYSTEM

E. R. Wagoner, *Assistant Forestry Educator,* and L. J. Beard, *Head, Communications Sub-Section, Texas Forest Service*

During the winter of 1944 Texas was plagued with a freak ice storm that disrupted telephone communications throughout much of the Pineywoods area of East Texas. Several hundred miles of Texas Forest Service telephone lines were made useless. An outbreak of fires following this storm would have caught Texas without a communications system.

Occurring as it did, during the critical days of World War II, the supply of both telephone and radio equipment was meager. In view of the emergency, however, the War Production Board authorized priorities to purchase a limited amount of radio equipment, but immediate deliveries could not be effected. Five used transmitters that had been operating on the 160-meter amateur band were modified and licensed to operate on 2226 kilocycles. As soon as available 30 commercial mobile receivers were purchased for mobile units.

Texas was the first southern State to make extensive use of aircraft in detecting forest fires. Twelve transceivers were installed in Civil Air Patrol aircraft. This early use of radios was considered a temporary measure as it was not planned, at that time, to replace the telephone equipment with radios. In fact, action was initiated toward moving telephone lines to more accessible locations along highways. The early use of radios sold Texas on the advantages of radios over telephones. The chief advantages were the economy of maintainance and the opportunity of maintaining constant communications with all mobile units.

Because of these advantages it was decided to build up a radio communication system around frequency modulated communications equipment.

Following World War II, the Texas Forest Service, a part of the A. & M. College System, felt that a task force, similar to that used in battle, could be used effectively to suppress forest fires. In building such a force to fight fires it is imperative to have mobility of transportation and communication. With this mobility, any unit or aircraft could be transferred anywhere it was needed in the State, without disrupting communications.

In most southern States, dispatching responsibilities are broken down on a county or a part county basis. Texas, however, has one central radio dispatcher for an entire district which contains three to ten counties. The dispatcher operates the main station, handling traffic with mobile units in his district, and with main stations in other districts (fig. 1).

Before any main station equipment was purchased, engineering tests were made to determine the type of equipment best suited for forestry traffic in Texas. Engineering tests were run with four mobile units and a station house receiver. Frequency modulated equipment replaced ampli-

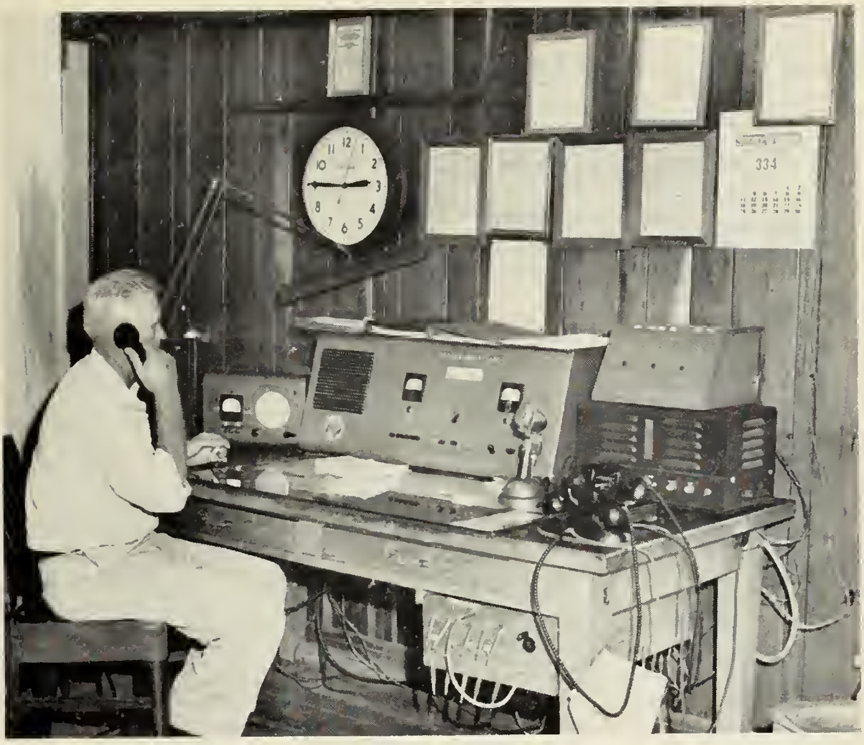

FIGURE 1.—Dispatcher O. H. Hill, District 3, Lufkin, and Texas Forest Service main station equipment for Radio Station KKB 849.

tude modulated. Five Texas Forest Service aircraft were equipped with Army surplus sets.

In 1950 the Service offered 1,400 miles of standing telephone line for sale. Funds derived from the sale of telephone equipment were used to purchase radios for lookout towers. It was found desirable to keep the tower traffic separate from the mobile unit traffic. To do this and avoid clogging one frequency, two tower frequencies were established. One or more towers in each district were designated as key towers. Other towers are called secondary towers. All towers communicate with each other, crossing out fires on 170.425 megacycles. Key tower traffic with main stations is on a frequency of 170.575 megacycles (fig. 2). After a fire is crossed out, it is reported to the dispatcher through the key towers. Ordinarily, the key towers are the only towers communicating with the dispatcher. If for any reason, a key tower is not manned, the dispatcher has a dual frequency receiver which enables him to monitor all secondary tower traffic.

The dispatcher is the key individual in the district communication organization. The mobile unit traffic, the aircraft traffic, and the tower traffic are all directed to the dispatcher for appropriate action. Traffic with cooperating organizations, such as the Texas National Forests, is also handled on 170.575 megacycles.

Radio equipment planned or in use for forestry traffic in Texas include:

One 250-watt base station at Fire Control Department headquarters.
Five 60-watt base stations at district headquarters.
Seventy 60-watt mobile units.
Five 10-watt mobile units converted for aircraft operation.

Two-thirds of the telephone line offered for sale has been sold. As funds become available from the sale of telephone equipment, radios are being purchased for tower installation. It is planned to equip 77 towers with radios to complete the radio communication system.

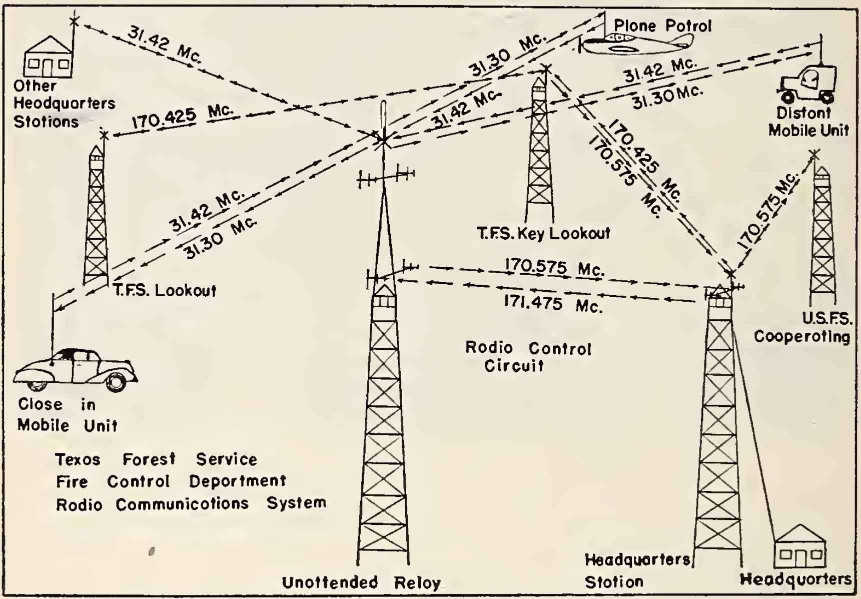

FIGURE 2.—Diagrammatic radio communications system.

Two of the administrative districts in Texas have peculiar shapes. The boundaries of these resemble a figure eight. For example, the distance across the district, that is north and south, is small compared to the distance from the extreme eastern point to the extreme western point in the district. It was difficult or impossible to communicate with mobile units in extreme corners of the districts. For this reason, it was found desirable to install bi-directional antenna at base stations in two districts. This fact alone makes Texas' communication system unique, since directional antenna are seldom used for forestry traffic.

One other district presents an unusual problem in that the district headquarters and base station are not situated at a central location in the district. This problem was solved by installing an unattended automatic relay at the highest point of elevation within the district. The unattended relay station is 18 air miles from the base station. Traffic is relayed to and from district headquarters through the unattended station. The unattended relay is equipped with a folded unipole and a six element beam antenna which is directed to the most remote corner of the district. Each antenna has its associate receiver and is selected by tone signals for transmitting purposes.

The three other 60-watt base stations utilize the conventional unipole antenna.

The Fire Control Department of the Texas Forest Service is organized around the district dispatcher to permit maximum speed of communication and transportation. It is intended that mobile units will be retained in their own district. But in case of an extreme emergency, the Texas system makes possible the transfer of fire suppression vehicles and aircraft equipped with two-way radios as a task force from one district to another without disruption of communication.

## PUBLISHED MATERIAL OF INTEREST TO FIRE CONTROL MEN

*Forest Fire-Danger Measurement in the Eastern United States,* by George Jemison, A. W. Lindenmuth, and J. J. Keetch, Forest Service. U. S. Dept. Agr. Handb. 1. December 1949.

*Public Education in Fire Prevention,* by Clint Davis, Director, Cooperative Forest Fire Prevention, U. S. Forest Service. National Fire Protection Association Proceeding of 54th annual meeting, 1950.

*New Machines Help Fight Forest Fires,* by John F. Loosbrock. Popular Science, September 1950.

*Smoke Jumping.* Kaiser Aluminum News, published by Kaiser Aluminum and Chemical Corporation, September 1950.

*You and Forest Fires.* A booklet published by Cooperative Forest Fire Prevention. Available through State Foresters or U. S. Forest Service. U. S. Dept. Agr. Program Aid 64. December 1948.

*Forest and Flame in the Bible.* A booklet published by Cooperative Forest Fire Prevention. Available through State Foresters and U. S. Forest Service. 1950.

*It Can't Happen to My Cottage!* A four-page paper illustrating fire hazards often found about a cottage. Published by Division of Forestry of California and U. S. Forest Service. 1949.

*Fire Damage.* An article on fire damage in its various forms and its effect on protection methods, by Charles Ament, California Forest and Range Experiment Station. Appears in September 1950 issue of California Agriculture, a publication of the College of Agriculture, University of California.

*Developments in Forest Fire Protection,* by A. A. Brown, Chief, Division of Fire Research, U. S. Forest Service. Published in National Fire Protection Association Quarterly, Volume 44, No. 1, July 1950.

*Forest Fires and Forest Fire Control in Michigan,* by J. A. Mitchell and D. Robson. A bulletin published by the Michigan Department of Conservation in cooperation with U. S. Forest Service. 1950.

*Chief Cause of Forest Fires,* by Asher W. Kelley, Jr., Assistant State Forester, West Virginia. In West Virginia Conservation, October 1950.

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*Ten Ways To Protect Small Woodlands From Fire,* by G. A. MacDonald. Progressive Farmer, Carolina-Virginia Edition, December 1949.

*Prevent That Fire,* by R. R. Waterer. In Forest Treasures published by Cyprus Forestry Association. Summer 1949.

*Significant Trends in Forest Fire Protection,* by W. B. Gayle. British Columbia Lumberman, December 1949.

(Continued on Page 13.)

# EFFECTIVE SUPPRESSION BY A SMALL HORSE-MOUNTED FIRE CREW

Gilbert B. Doll

*Assistant Supervisor, Toiyabe National Forest*

The Jack's Springs fire started on July 1, 1950, and in the next three days spread over 2,075 acres of noncommercial forest land. The area in which this fire occurred is semidesert characterized by steep canyons. The predominate cover is pinyon-juniper and sagebrush. The soil is sandy. Many dead logs and trees scattered through the green growth on the area caused considerable spotting and quite a roll problem. The suppression job was mainly one of hot-spotting and fuel robbing.

Of particular significance in planning the suppression action was the inaccessibility of the fire. It was 10 miles airline from the nearest roadhead. The distance was not too important because we have often walked men farther and in more rugged country. Walking in the *loose sand,* however, through broken country with temperatures in the 90's increased the fatigue factor so much that it was believed equal to that of more than double the travel distance. For example, the first crew of nine men reached the fire nine hours after leaving their truck; the second crew of 18 men walked 12 hours after leaving the roadhead. They averaged less than a mile per hour travel time. The men were physically exhausted upon reaching the fire and the fact that they did some effective work was mainly because they drove themselves to continued effort. Both crews had hospital cases due to heat exhaustion and sore feet. They failed to hold the fire and it made runs the afternoons of July 1 and 2.

Aerial scouting and information obtained from other sources led to the decision that an entirely different plan of attack was necessary. We could either: (1) Use smoke jumpers, not immediately available. (2) Use from fifty to one hundred men along the 12-mile fire perimeter, hold crews in relatively small working areas, and subsist and bed down right on the line in order to decrease the walking fatigue factor. (3) Use a small, well-trained crew of horse-mounted fire fighters.

Considering values, costs, distances, and other factors it was decided to use the horse-mounted crew. They could travel fast, cover a lot of fire line hot spots, and camp on water and still reach the fire by daybreak; they were economical and easy to outfit; and they were immediately available. A new base camp was established at Jack's Springs, the closest water supply, 5 miles from the fire.

The first attack ground crews were released the evening of the second day. A well-organized crew of four working overhead and six fire fighters, each mounted on a horse, and each self-sufficient, hit the fire at daylight on the third day and had covered the entire fire line by 11 a. m.

Hot spots that flared up, as far as a quarter of a mile away, were reached in fast time and since the men were not exhausted from walking in the loose sand their work was considerably more effective. The fire was held on the third day except for one small slop-over of 5 acres. Again the next day, the mounted crew hit the fire at daylight and by midafternoon had it under control. The fire was then turned over to a five-man mounted mop-up crew.

Of course, all such fires cannot be suppressed by a small crew, yet this experience did point up a few things important to the control of fires in inaccessible pinyon-juniper areas of low timber and watershed value. Some of these are:

1. Fatigue, merely from walking, is an important factor in control of fires in hot, semiarid areas. In this case, the extreme fatigue from walking to the fire and around it resulted in several injury cases. We can assume that the number of such injuries would have increased proportionately had larger numbers of men been used.

2. A well-organized horse-mounted crew could reach dangerous spots anywhere on the line within a few minutes; the men were fresh and ready for a tough job. In this case, men worked in pairs under a boss who scouted out his sector and then used his crew most effectively. The fire boss rode the entire fire line, catching dangerous hot spots as he went or directing crews to them. This small mounted crew replaced fifty to one hundred conventional foot fire fighters.

3. There was a tremendous saving in costs as well as a big reduction in the job of transporting, feeding, and supplying crews. Foot crews would have cost from $3,000 to $6,000 for the 2-day job while the horse-mounted crew actually cost about $500.

4. There was a considerable reduction in actual hours of fire fighting time. The horse-mounted men got their needed rest because they did not need to walk half the night getting into positions on a fire line.

5. Each man was independently outfitted. They arrived on the job fully equipped with tools, hay and grain, and food enough for a week.

The suppression action taken in this type of semidesert country proved to be efficient and economical.

## Television for Fire Control

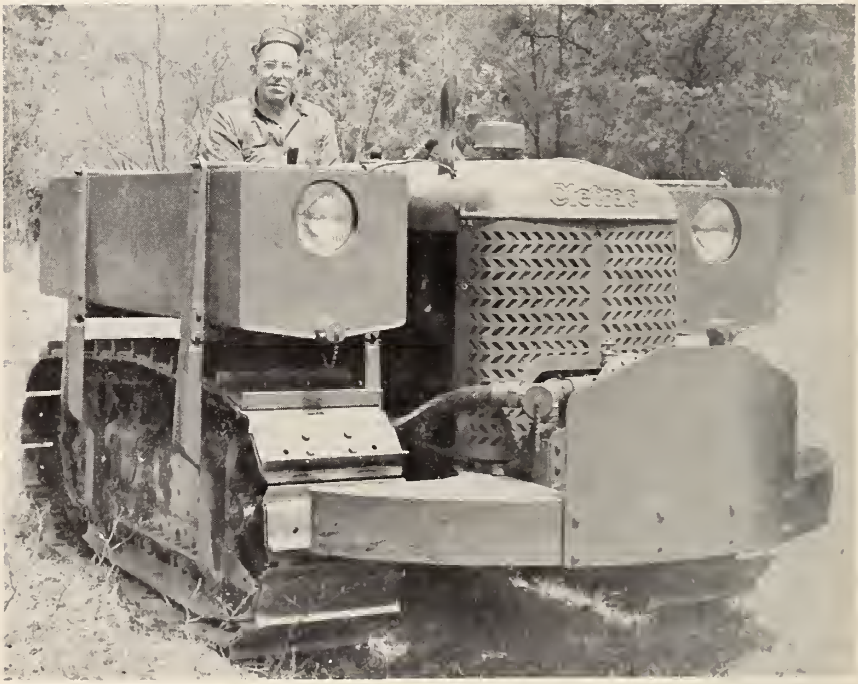
"An uncommon and interesting use of television in fighting forest fires appears to have been applied for the first time in Bechuanaland [Union of South Africa]. In April 1949 two planes, one equipped with a television camera and the other used as a relay, were flown along the front of a vast forest fire stretching for about 20 kilometers. The pictures broadcast gave the Forest Inspector in his office a general view of the advance of the fire and of the various phases of the struggle against it conducted several kilometers away by the forest rangers, farmers and firemen who had been called to the area; this 'first-hand information' allowed for effective command decisions in fighting the fire."—From UNASYLVA 4(3):142. (An International Review of Forestry and Forest Products, published by Food and Agriculture Organization of the United Nations.)

# MICHIGAN TRACTOR-TANKER

Gilbert I. Stewart

*Supervisor, Michigan Forest Fire Experiment Station*

A tractor-tanker unit has been developed by the Michigan Department of Conservation at the Forest Fire Experiment Station, Roscommon, Mich. It is based on a wide gage crawler tractor, model AG-6. Mounted on the front of the tractor is an industrial model pump employing rubber rotors. The pump is assembled into a compact gear housing that develops proper pump speeds, and is driven by a front power take-off. The tractor driver can operate the pump at will by means of a selective clutch. A proved type of bumper and guard, which has been standard with the Michigan Department of Conservation since 1935, is installed at the front of the tractor. This has been improved and altered to provide the proper mounting for the pump.



Michigan tractor-tanker.

Two 135-gallon tanks are mounted, one above each track frame. The entire tank assemblies are borne by the track frames, and no weight of water or tank apparatus is attached to the tractor frame itself. The headlights are recessed into the bodies of the tanks, thus giving a cleaner silhouette to the machine. Tanks are designed especially for this job and may be secured commercially. Features of the tanks include bolt-down tops permitting easy cleaning and interior maintenance; perforated pipes open at both ends of the tanks and run the full length to permit complete flushing of the tank interiors without the tops being removed.

The left tank includes a live reel with a hose capacity of 100 feet; the rear of the right tank accommodates the battery. Valves permit water to be circulated free of pressure within the tank systems, or to be passed under pressure into the live reel at will; the pump is thus primed at all times and ready for immediate use, Shut-off nozzle guns are used with this machine. The pump installation has been designed to permit pumping from the mounted tanks or from a tanker trailer towed behind the machine, or it may be employed for conventional line pumping. Pressures range up to 200 pounds and capacities up to 40 gallons per minute.

Full tool equipment is contained in a sturdy tool box mounted on one tank; a tray on the right tank allows convenient access to shovel, ax, chain, or other accessories issued and used with crawler tractors.

The unit shown is the pilot model completed in May 1950 after almost 2 years of experimental development at the Forest Fire Experiment Station. Total cost is not yet known for volume production but may be estimated at about $600, excluding tractor. During development all necessary tooling, such as patterns for castings, templates, jigs, fixtures and similar accessories for production, was completed. The entire outfit can be manufactured in kit form ready for installation onto any AG-6 tractor. The same type of assembly will be worked out for D2 and D4 tractors.

(Continued from Page 9.)

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# MAINE'S NEW FOREST FIRE PROTECTION PROGRAM

A. D. Nutting, *Forest Commissioner,* and Austin H. Wilkins, *Deputy Forest Commissioner, Maine Forest Service*

The Maine Forest Service has recently completed the first year of a new forest fire protection program. It is the outgrowth of object lessons learned from the Maine 1947 forest fire disaster and followed by the enactment of certain forest fire laws in 1949 by the Maine Legislature. The major law provides, for the first time in the history of the Forestry Department, full responsibility for forest fire control over the entire State. This is the foundation upon which the new set-up is being administered.

Some background information is needed if one is to fully understand the reason for the changes. In Maine there are 16,692,000 acres of forested area to be protected against fire. This represents 84 percent of the total land area of the State. It should also be pointed out that 97 percent of the forest area is in private ownership.

The Maine fire of 1947 destroyed 102 houses in this town. Such devastation as this resulted in the new forest fire protection program.

In the economic development of the State, the forested areas fall into two distinct geographical divisions. The northern part of the State is made up of a vast unbroken area of wildland townships except for a potato-growing farming section on the eastern border. It is an area with few roads, almost no permanent population, and rather rugged terrain. Here the problems of forest fire control are different from those anywhere else in Maine. In the early 1900's, there was no State control organization and serious forest fires occurred. Landowners became concerned over their annual fire losses. As a result of their efforts the Maine Legislature in 1909 passed a law creating the Maine Forestry District. It placed forest fire control for this vast northern Maine wilderness area under the State Forestry Department. The forest commissioner was charged with the prevention, control, and extinguishment of all forest fires within the District.

A unique feature of the act is the special levied mill tax which provides funds to administer the forest fire control program for that area. The tax has varied over the years and is at present 5 mills on every dollar valuation in the District. Annual income is $300,000. This money can only be used for forest fire protection purposes. It is believed that there is no other State with a similar law providing for a special forest fire tax on all privately owned land in unorganized towns. The fire record can be considered good since 1909. This is probably due to State centralized control and authority.

The Maine Forestry District for administrative purposes has four divisions, each under a supervisor. The four divisions are subdivided into 25 warden districts, the size and bounds determined largely by watersheds, accessibility, etc. Each district is under the direction of a chief warden. The Forestry District has constructed and maintains 77 lookout towers, 2,500 miles of woods telephone lines, and many camps and storehouses. The District has 2 airplanes and some radio installations. Wardens are provided with ½-ton pickup trucks, patrol boats and canoes, portable power pumps, hose, back-pack pumps, and hand tools. All personnel except supervisors and one pilot are seasonally employed (April to November).

In direct contrast to the District set-up are the organized towns of the State. The term "towns" refers to the 450 organized municipalities, administered by boards of selectment and assessors, the New England town form of government. These towns are in the southern half of the State for the most part. The forest area is 6,430,000 acres. Here the forests are small, broken-up tracts with thousands of ownerships. In general it is an area with many roads, densely populated sections, and high fire occurrence but with some towns of small population closely resembling the Forest District.

From 1891 to 1949 the individual towns have been responsible for their own forest fire control. The State never had jurisdiction and served only as a cooperator. Over the years the State has gradually increased its assistance to the towns because many of the problems could best be met at the State level. This assistance consisted of the construction and maintenance of 20 lookout towers, a number of camps, and storehouses, and employment of 13 state wardens as cooperators in forest fire fighting and for training with trucks and equipment. Since 1945 the State has reimbursed towns one-half of suppression costs up to 1 percent of the town's valuation.

Under this old system, the towns were confronted with problems which they could not handle. This was especially true when forest fires crossed town lines or became very large and expensive. The forest fire disaster of 1947 brought many of these problems out in the open and aroused public opinion to the point that the situation had to be corrected.

To meet the public demand for corrective measures the State Forestry Department conducted an intensive survey. During 1948 the department held 300 public meetings to determine what the people wanted for a program. From the many ideas and suggestions obtained an outline plan began to jell. After further study and contacts with selectmen, fire chiefs, wardens, landowners, and others, five major forest fire bills were drafted for legislative consideration. Resulting laws were finally enacted by the 1949 Maine Legislature and became effective August 6 of that year.

In brief these forest fire protection measures are as follows:

*State forest fire prevention and control in organized towns.*—This law established a set-up plan from former State cooperation with towns to State forest fire control in all organized towns, cities, and plantations. It provides for an unbroken chain of command from town forest fire warden to commissioner. A maximum amount of responsibility and authority will remain with each local community, but State authority is provided whenever the town system breaks down.

To administer this program, the forest commissioner shall divide the organized towns into major forest fire control districts. These shall be subdivided into as many smaller units as deemed necessary for effective protection against loss or damage by forest fires. The forest commissioner may also establish lookout towers connected by telephone or radio; construct, equip, and maintain office-storehouse headquarters for necessary supplies, tools, and equipment; and provide for any other construction essential for forest fire prevention and control work.

The law further provides for the appointment of full time State forest fire wardens. Their duties shall consist of supervision of State personnel and equipment in their respective districts for the prevention, control, and extinguishment of forest fires. They also shall enforce all laws relating to forests and forest preservation and shall have the same power of arrest to serve criminal processes against offenders as a sheriff or his deputy. In addition these wardens shall be responsible for carrying out a program of forest fire prevention education, prepare and revise annually a forest fire plan for their districts.

State seasonal forest fire wardens shall be responsible to their district warden.

It is important to note here that management of town forest fires shall be the responsibility of the town forest fire warden until, in the judgment of a State forest fire warden, the situation makes it advisable for him to take over. Final authority and responsibility on forest fires shall be that of the State forest fire warden. Town fire department personnel and equipment shall not be moved within or outside the town limits except with the approval of the fire chief or proper town official. Such officials shall have the authority to determine whether town fire department personnel or equipment is needed on a forest fire or to protect buildings.

Only State forest fire wardens shall have the authority to set backfires.

Provisions are also made for the Forestry Department to formulate plans of action to establish manpower pools, equipment reserves, facilities for feeding fire fighters, transportation and communication on forest fires.

*Appointment of municipal town forest fire wardens.*—The forest commissioner shall appoint a forest fire warden for a 3-year term in each organized town, city, and plantation. Such appointments shall be made with the approval of the municipal officers and does not constitute State employment. A municipal officer, fire chief, fire ward, or any other citizen is eligible for appointment.

The State appointed town forest fire warden shall receive an annual fee of $50 from the State. Payment is contingent upon attendance at forest fire training schools and preparation of an annual forest fire plan for the town. This forms the nucleus for a well-trained force of 450 town forest fire wardens and 1,500 deputy town wardens.

Services by these wardens for work on actual forest fires shall be paid by the town and at a rate determined by the town.

*Forest fire fighter pay and aid to towns in controlling forest fires.*—In the past many towns of small population have been hit hard by heavy forest fire suppression costs. Many bills went unpaid. Some towns sought reimbursement through the legislature while others borrowed money from banks and made payments prorated over a period of years.

Under this bill the suppression cost burden is eased by the State paying one-half of the suppression costs up to 2 percent of the town's valuation. All suppression costs in an amount greater than 2 percent of the town's tax valuation shall be paid by the State.

No State reimbursement payments shall be made until the town first shows certified payment. All qualifying costs must be approved by the State forest fire warden in charge. Requests for reimbursements shall be presented within 60 days after total extinguishment or become void. Time extension may be granted after major forest fires.

*Slash and brush disposal.*—This law provides that all slash must be removed a distance of 50 feet from the nearer side of all publicly used roads and on request by adjacent owner 25 feet from property lines. This must be done within 30 days after cutting or 30 days of notification to remove by the forest commissioner or his representative.

This act further provides that no person shall kindle a fire to clear land or burn logs, stumps, roots, brush, slash, fields of dry grass, pastures and blueberry lands, except when the ground is covered with snow, without first obtaining a burning permit. These are issued by State wardens in the Maine Forestry District and town forest fire wardens in the organized towns. Penalties are imposed for violations of this and the slash removal requirement.

A new prevention measure under this act is the hazard clearance around town and private dumps. A cleared strip 10 feet wide to mineral soil must be constructed on all sides of the dump, except when bordering on or near a large constant supply of water sufficient for protection. In addition all grass, weeds, slash, brush and debris, and other flammable material shall be removed for a distance of 100 feet in all directions from the cleared mineral soil strip. Live trees need not be removed except that dead and green branches of conifers or evergreens shall be pruned to a height of 10 feet above the ground.

Town and private dumps may be closed by the State or town forest fire warden if the provisions of this section are not carried out. Many towns have dumps which are near woods and constitute a forest fire menace. To meet this problem towns are being encouraged to relocate to a safer place or construct a suitable public incinerator. In some instances towns are using trenches and covering the debris with bulldozers.

*Primary wood-using portable sawmills, spark arrestors, and timber reports.*—All primary wood-using portable sawmills must be licensed and require a fee of $25. Failure to secure a license is punishable by either a fine or jail sentence or both. An added forest fire prevention measure calls for a hazard clearance of all slash for a distance of 50 feet in all directions from the mill, sawdust pile, and incinerator. Live trees need not be removed but dead and green branches of conifers or evergreen trees shall be pruned to a height of 10 feet above the ground. The area for the sawdust pile shall be clear of all trees and located not less than 25 feet from an incinerator. The sawdust pile shall be reasonably free of slabs and edgings.

The act further provides that all primary wood-using portable sawmills shall be equipped with a forest fire tool cache not exceeding a cost of $25 for each mill.

For many years the State has been without any accurate information on the annual timber cut. Under this act all owners or operators of primary wood-using sawmills, stationary or portable, shall make an annual report to the forest commissioner of the amount of softwoods and hardwoods sawed within the State.

## Conclusion

During 1948 and the spring of 1949, the State Forestry Department had the voluntary authority and expanded aid from State funds to handle forest fire control before the new forest fire laws became effective. Since enactment of the 1949 laws there is reason to believe that the new program has proved itself.

Morale is high among the State and town forest fire warden personnel who are a part of an organization making every effort to establish better fire protection in the State. This has been accomplished by a series of intensive training schools. Emphasis has been placed upon prevention-education work, case history studies of forest fires, demonstrations in handling crews and use of equipment, training of volunteer groups, and other public relations work.

From 1947 on, Maine has experienced four consecutive years of drought with an increasing number of forest fires. Yet better forest fire control and authority have prevented any serious reverses.

The recent Greenfield-Townships 32, 33, and 39 forest fire of 7,300 acres was a good example of coordination and supervision under one authority. Under the old system it would not have been possible to pay all the suppression costs on the Greenfield end of the fire. The new program provided full financial payment to all fire fighters and for use of equipment.

Sufficient funds were provided to increase the warden service, to construct 7 lookout towers and 18 office-storehouse headquarters, and to purchase 20 ½-ton pickup trucks, 25 portable power pumpers, large quantities of hose, knapsack pumps, hand tools, and radio equipment.

Radio communication was undoubtedly one of the most progressive protection measures under the new program. The State Forestry Department now has a State-wide network of 9 lookout tower radio stations. In the organized towns the entire State warden service will shortly be equipped with mobile sets installed in ½-ton pickup trucks. There are also a number of handy-talkie sets. Similar mobile installation is planned for wardens in the Maine Forestry District.

Two other important measures which will strengthen the fire protection program of the State are the preparation of a State forest fire plan and participation as a member of the ratified Northeastern Interstate Forest Fire Protection Compact.

Volunteer public cooperation to control forest fires usually develops only after a disaster has taken place, and is too late to prevent hardship and loss. Such a situation must never be permitted to occur again. It is hoped that under a single authority this new program will provide the necessary forest fire protection in Maine.

## Box and Crate Construction for Safety

Safety pamphlets, leaflets, and instructions continually stress the importance of lifting with the legs instead of stooping over a heavy object and lifting with the back muscles, a practice which causes sprained backs, injured vertebrae, ruptures, and other semipermanent and permanent injuries.

On all units I have visited, almost invariably boxes that house heavy objects, i.e., pumpers, grinders, stoves, and other equipment, have an ordinary rectangular box with a hinged lid on top. When one man is required to remove the object from the box it is a physical impossibility for him to lift the object properly because the box is in the way. The effort in lifting is exaggerated simply because the man lifting must keep his knees straight, bend over off-balance and lift the object straight up, throwing excessive strain on leg muscles, knee joints, back and shoulder muscles.

Would it not be a good idea to move the hinged lid from the top of the box to the bottom on the side or end so the object to be removed can be slid out of the box with much less physical effort and strain?

All boxes constructed at the Mendocino warehouse for housing heavy objects of 50 pounds and over now have a cover hinged to the side so that no lifting is required to remove the object from the box.—AL EDWARDS, *Warehouseman, Mendocino National Forest.*

[In other regions a special box has been used for heavy equipment, such as pumpers. The pumper is secured to the bottom of the box. The rest of the box serves as the lid. It is fastened to the bottom with four hasps and is removed in one piece. Devices such as this author presents will undoubtedly pay dividends, in fewer injuries, where heavy equipment is involved.—Ed.]

# SALMON HOSE ROLLER

R. Boyd Leonard

*Fire Control Officer, Salmon National Forest*

The cleaning and rolling of hose after it has been used is normally a tedious job. It is not only time-consuming, but the roll is often untidy and loose. We then experience difficulty in handling and storing, and frequently the rolls come undone when we pick them up hurriedly to send to another fire. The most common method of rolling hose is by hand. To do an effective job by this method takes two men and an estimated 2 minutes per roll of hose.

In order to overcome the difficulties experienced in properly rolling hose by hand, an effective and durable hose roller was designed by Kenneth Call, fire dispatcher, Salmon National Forest (fig. 1). Advantages of such a roller were immediately apparent. It cut down the time required to roll hose and eliminated one man from the operation; neat compact rolls were secured (fig. 2). The roller is simple, inexpensive, and designed to make it easier and faster for one man to roll fire hose. It is constructed of:

4 pieces of 2x4, 2 feet long
2 pieces of 2x4, 2 inches long
1 2x6, 2 feet long
1 ½-inch rod, 24 inches long
1 screen door spring hinge
1 nut and washer
a few nails.

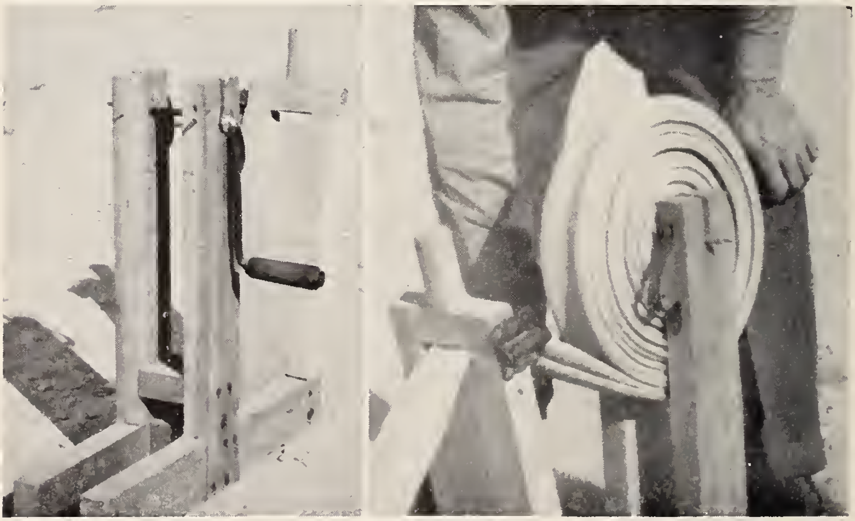


Figure 1.—Salmon hose roller: *Left,* Parts in place; *right,* roll being made.

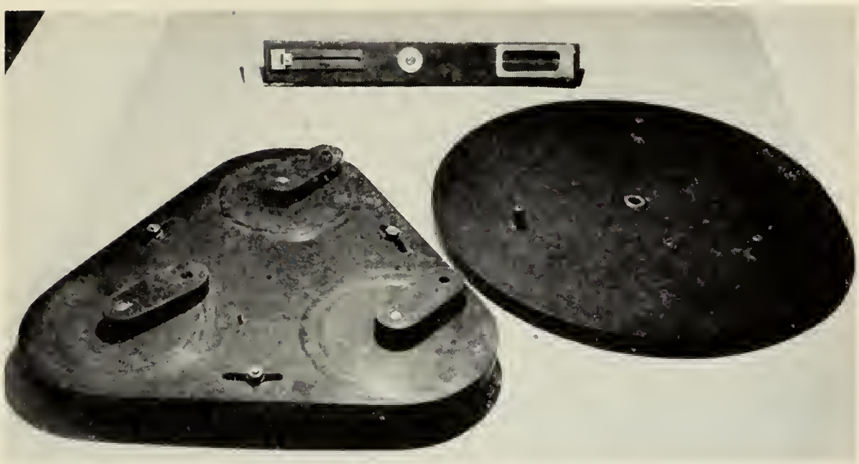


Figure 1.—Fire finder before assembling, showing platform with parallel linkage and under side of map board.

mitted some error due to imperfect centering of the eye on the slot. The 3/32 inch width was selected as the best under most conditions.

At the rear sight end of the alidade is fastened an index plate of ¼ inch clear Plexiglas, with a red index line engraved on its under side for reading the graduated circle. The alidade is set so that the index plate rides about 1/16 inch above the circle, and may be pressed down against the circle when reading a direction. The index mark then being in contact with the graduations, all chance of error due to parallax is eliminated.

The azimuth circle is printed on a sheet of Ozaplastic 15 inches in diameter. This is a paper coated on both sides with a plastic material, and sensitized with an Ozalid solution for contact printing. The original was drawn on acetate sheeting, and prints were made in a vacuum frame to eliminate any possible distortion of the image which might be caused by slippage or crawling in the usual rotary printers. This sheet is carefully centered on the axis of rotation of the alidade, and cemented to the board with a resorcinol resin glue. The circle is graduated to single degrees. Since on this large circle azimuths may be estimated to one-half or one-quarter degree, and since no smaller interval than this can be platted on the dispatcher's maps now in use, no further subdivision of the full degrees was considered necessary. If readings to a smaller interval are desired, it is a simple matter to add a vernier scale on the under side of the index plate, reading to 15, 10, or 5 minutes of angle.

Before placing the fire finder in the tower, azimuths to several check points visible from the tower are marked in ink on the graduated circle. True azimuths to these points are being determined by triangulation survey covering all our towers, which is now in progress.

The original model of this fire finder included a map which was cemented face up to the under side of a circular disk of Plexiglas ⅛ inch thick. On the upper side of the Plexiglas was engraved the graduated circle, the incised lines being filled with red ink. The disk and map were then cemented to the map board. The alidade carrying the sights was made of clear Plexiglas so that the map could be read through the forward end of the alidade. However, serious difficulties, and some additional expense, were encountered in assembling the map and disk. Since our towers have for several years been provided with a small crossing map similar to the dispatcher's map, it was decided to eliminate the map from the fire finder, and the present simpler arrangement was adopted.

The instruments are being manufactured in our own machine shop, no special equipment being required other than the tools generally found in such shops. Total cost of materials is about 5 dollars. Plans or additional information may be obtained from Director, Division of Forestry, Department of Conservation, State Office Building, St. Paul 1, Minn.

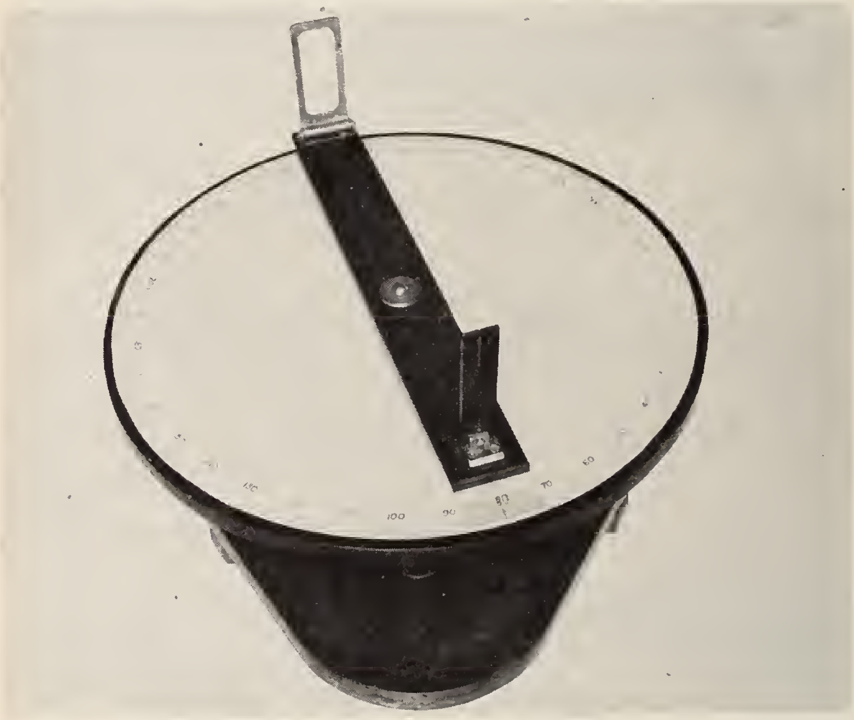


Figure 2.—Fire finder assembled for use.

# PORTABLE, COLLAPSIBLE FIRE CAMP TABLE

J. W. Mattsson

*Forester, Division of Fire Control & Cooperative Forest Protection, Region 4, U. S. Forest Service*

We have constructed a few collapsible fire camp tables, based on plans prepared by other regions plus a few alterations of our own. It was felt that such tables could be used to good advantage and save considerable time and effort. Very often rough tables have been constructed at fire

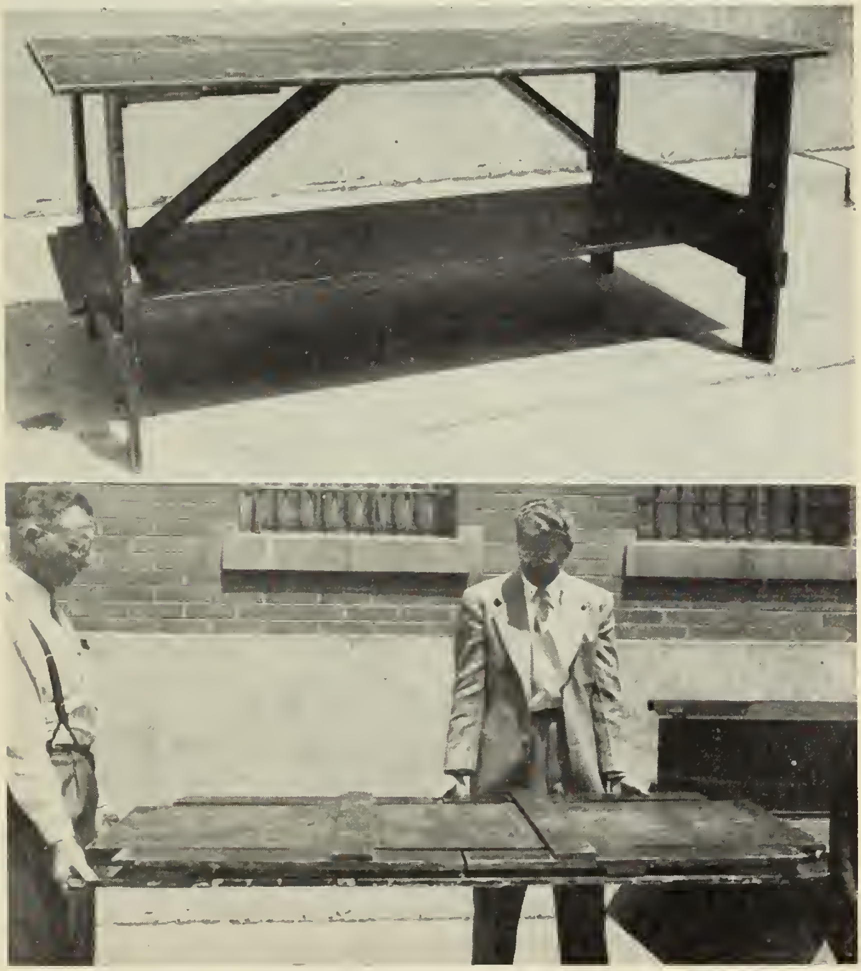


Figure 1.—*Top,* table in upright position. Note wide top and shelf below. The diagonal braces insure a rigid table. *Bottom,* fully collapsed table takes up little space in the bed of a pickup.

camps, even when such camps were accessible by truck, at the expense of many man-hours that could have been spent more profitably on direct suppression. These collapsible tables are practical, and are not too difficult or expensive to construct. They have proved their worth for emergency fire use as well as at insect control and other field camps. On a fire their use is multiple; they serve such purposes as work tables for the kitchen, mess, fire boss, camp boss, and timekeeper.

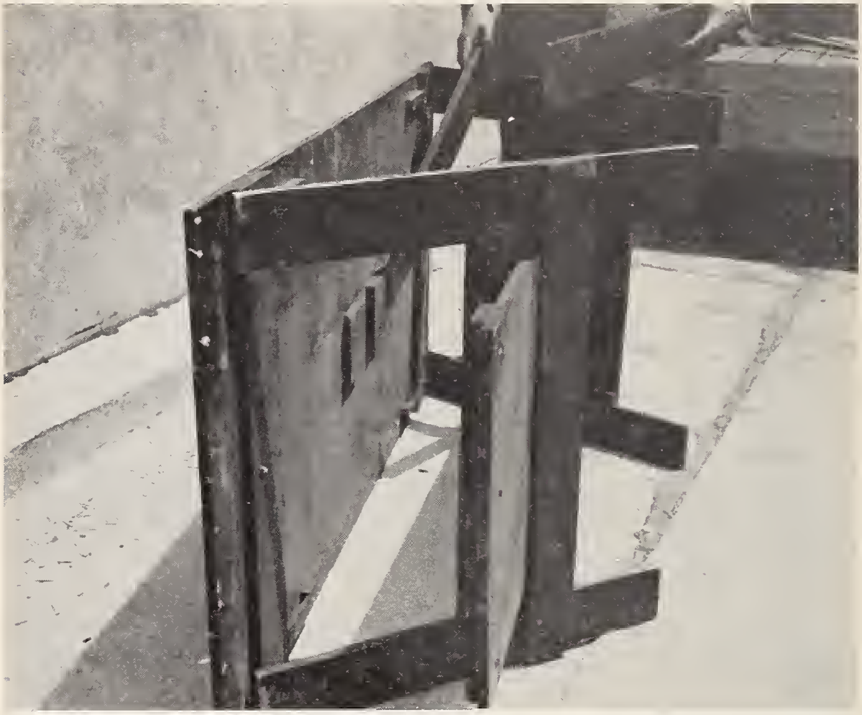
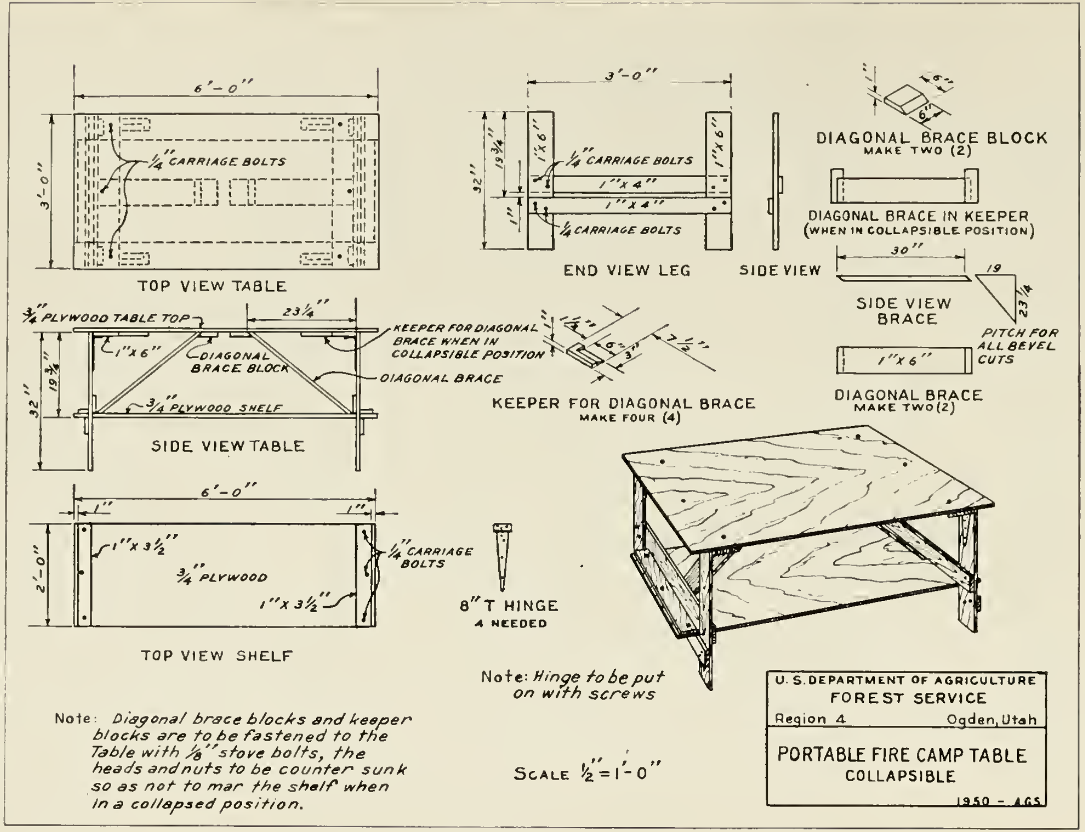


Figure 2.—Table partially collapsed showing how diagonal braces are set in. These braces are an important part of the table. They give it the necessary rigidity and solidness.

Construction is rugged enough to take a lot of abuse and the collapsible feature makes it possible to drop the tables in the bed of a truck and load whatever is needed in the way of tools and supplies on top. They can be set up or taken down in a matter of seconds since there are no bolts or screws to remove or replace (figs. 1 and 2).

If such tables are to be used where a smooth surface is desired, it is recommended that ⅛ inch masonite top cover be placed on them. This would increase the life of the table top, provide a smoother writing surface, and also facilitate cleaning.

Figure 3 illustrates the details of construction. Substitutions of materials, of course, can be made if desired. Its construction does not require an expert carpenter. Considerable care, however, should be given to the construction and placement of the diagonal braces and brace blocks to insure a good tight fit.



Note: *Hinge to be put on with screws*

Note: *Diagonal brace blocks and keeper blocks are to be fastened to the Table with 1/8" stove bolts, the heads and nuts to be counter sunk so as not to mar the shelf when in a collapsed position.*

FIGURE 3.—Construction plans for collapsible fire camp table.

# GETTING A NEW LOOK IN FIRE TRAINING

John E. Burt, Jr.

*Deputy State Forester, Utah*

How to combat 300 fires a year without funds to employ a full time fire organization has been the problem of both the Federal agencies and the State. Per diem fire fighters is our answer—cooperators from all walks of life, paid only when they fight fire. In order to make these cooperators effective fire fighters a great deal of effort has gone into fire training.

The fire control agencies in Utah have developed an interagency organization known as the Utah Cooperative Fire Fighters. This organization is headed by a coordinating committee, with a deputy coordinator from each agency, and the State forester as State coordinator. Each county in turn has a coordinator and assistants. Through this organization Federal, State, and county agencies can pool their efforts to train and tool fire fighters and coordinate their efforts in prevention and suppression work.

It has been the practice of the coordinating committee to meet early in the year to plan a spring training program to be taken to the field. When the group met in February this year we pointed out that our past training was lacking in certain fundamentals. Too many fires blow up because in our training we failed to put across the idea of proper mop-up. Another weakness was the proper handling of small crews in line construction. Better straw-boss training was needed.

This year the coordinating committee felt that a better job could be accomplished if members of the field organization participated. The State was divided roughly into four districts and three people from each district were invited to assist the coordinating committee in developing a program, including heavy emphasis on mop-up, organization and handling men in line construction, and safety.

The three people from each district, the coordinating committee, and Mr. Von Robertson from the State Education Department met in Salt Lake City on March 16th and 17th. The first day was an indoor session where everyone participated in planning a training outline. The second day was a field day in which we developed the training techniques to put over our training subjects. It was very difficult for most of us, as fire fighters, to think in terms of teaching and here Mr. Von Robertson came to our rescue. Too many times at fire schools we have gotten away from the job of teaching by putting out the fire.

We developed a rough outline of the various teaching steps as we demonstrated them in the field. This was later polished up, mimeographed, and sent to the field force. It consisted of three sections: Basic training fundamentals, planning the actual training program, and putting on the training program.

The three men from each district attending the planning session became a committee responsible for their own district fire school. Members of the coordinating committee participated in each of the four schools, acting as trainers and critics. County coordinators and assistants plus key people from all agencies were invited to attend the four district schools. Each school consisted of a six-hour program as follows:

1. Inside or outside orientation and outlining of program. Getting acquainted and letting the trainee know what he is expected to learn. 30 minutes
2. Field orientation and travel to practice site. Prepare trainee. 10 minutes
3. Assembly of men at practice site. This involves parking cars safely, unloading, and walking to selected area. 10 minutes
4. Training in progressive line construction. Telling, demonstrating, practice and critique. 1 hour
5. Presentation of mop-up. Explain reasons for good mop-up practice. Explain three phases of mop-up, primary, intermediate and final, and point out problems of each. 30 minutes
6. Demonstrate and practice on mop-up problems. Tell how, demonstrate, let trainees practice, put them on their own. 1½ hours
7. Review action taken on practice problems by all trainees. Final group critique. 1 hour

We have found that even with this limited subject matter our time was too short.

The new look came to our training by placing the trainee in the position that he was a teacher who in turn would have to teach someone else, and by following teaching fundamentals. This resulted in each man thoroughly learning the subject. Everyone was very attentive and participated with comments and questions. The summing-up period or critique was the clincher. We first let the trainee criticize the trainers and himself, then the critics made a summarization. From one of our meetings came the very applicable comment that we have had 10 to 25 years experience but we are still using only our first year's experience. This came from Richard Greenland, a district land manager, who feels that now with this training we are adding to that experience.

The four district meetings were very successful because they were planned and organized by the men who had helped develop the program. A great deal of time and effort was spent in this planning and preparation. These meetings were attended by a total of 210 people who represented Federal, State, and county agencies.

The trainees attending these district schools then carried out the same program in their local schools with a great deal of success. More than 500 fire fighters were trained at 20 local schools in May and June.

We hope to follow through on this program next year, choosing another phase or two of fire control and teaching it thoroughly.

Outlines have been furnished all regional foresters and State foresters. Some of the State foresters have been very complimentary in their comments. [The Utah State Board of Forestry and Fire Control, School of Forestry, Logan, Utah, has available a comprehensive mimeographed publication, Suggestions and Guide Points on Planning and Conducting a Cooperative Fire School.—Ed.]

# A SIMPLE METHOD OF DESIGNATING MAP LOCATIONS

Robert F. Collins

*Forester, Region 7, U. S. Forest Service*

A problem confronting any forest fire control organization is that of identifying a point on a map in a manner that will permit a person on the receiving end of a telephone or radio transmission to locate quickly and accurately the same point on his map.

One solution is afforded by the "thrust-line" method. This method is frequently used by the armed forces in situations where gridded maps are not available. In the most simple form it may be applied as follows:

1. Select two readily identified points on the map in the general area to be worked and as far apart as is convenient.
2. Connect them by a straight line. This is the "thrust line."
3. Designate and label one of the points as the "initial point" (I.P.). All measurements start at this point.
4. Any location on the map may now be designated by a symbol consisting of two parts: Distance along the thrust line from the I.P., either forward (F) or back (B); distance right (R) or left (L) from that point at right angles to the thrust line.

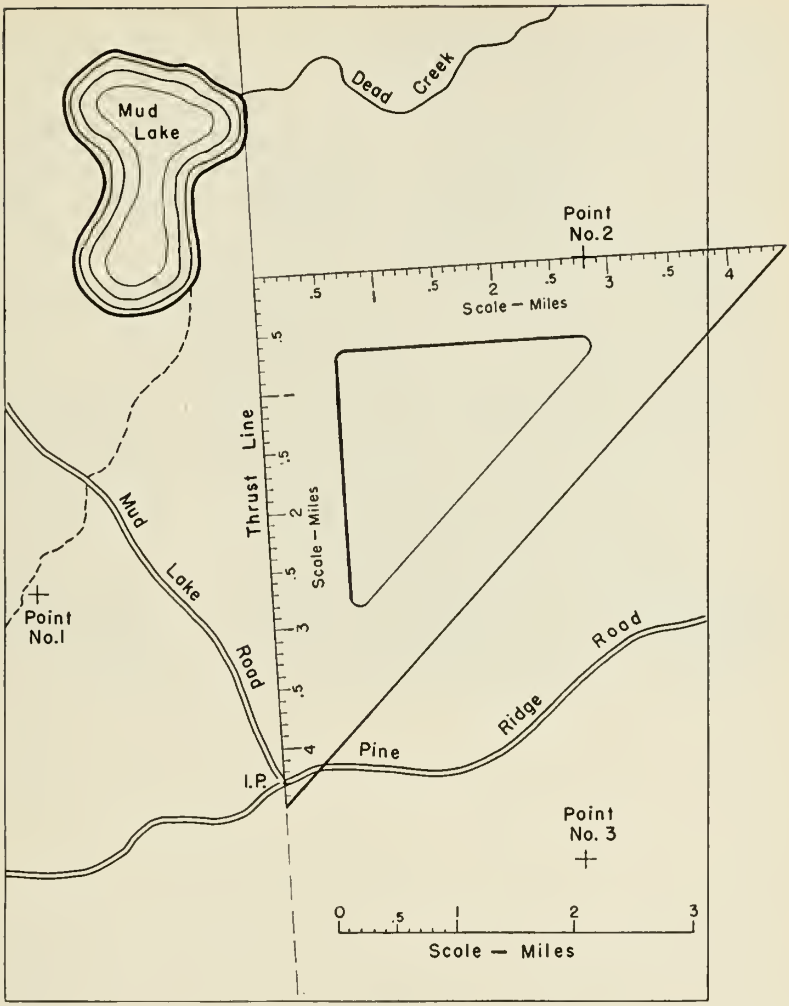
An aid in applying this method is a paper, cardboard, or plastic right triangle having both of the sides graduated in the major map units and tenths of units, the zero of both scales being at the right angle of the triangle. By laying the triangle along the thrust line with the "zero" forward and the required "F" distance at the I.P. the "R" or "L" distance may be plotted directly.

An example of the use of the thrust-line method is shown by the sketch map. Point no. 1 is designated as *F* 1.7 *L* 2.0. Point no. 2 is identified as *F* 4.3 *R* 2.8.

Many variations of this method may be developed to meet the need of special situations. Where a large area of map is to be covered it is best to establish several thrust lines well distributed over the area to be worked. In such cases it is necessary to identify each thrust line by a letter or number and to preface each point description by the identifying letter or number of the thrust line to which it pertains. For example, if the thrust line shown on the sketch map is thrust line III then the identifying symbol of point no. 2 would be *III F* 4.3 *R* 2.8.

In some cases it is necessary to place the I.P. well into the map because there is no easily identified point near the edge. In such cases the thrust line may be extended to the edge of the map and points on this extension shown as back (B) measurements. For example point no. 3 on the sketch map would be identified as *B* 0.8 *R* 2.5. In all cases right and left are determined on the assumption that the observer is facing forward from the I.P.

The thrust-line method is most useful in cases where maps having grid lines or regular GLO subdivision land lines are not available. In an emergency the ordinary service station road maps can be used in combination with the thrust-line method to good advantage.



Sketch map with graduated triangle placed on thrust line to locate point no. 2, *F* 4.3 *R* 2.8.

When two observers are using maps of different scale the same thrust-line symbols apply to both. However each observer must plot locations according to his own map scale.

The principal advantages of the thrust-line method are: It is simple to teach and use. It may be applied to any map. A single identification symbol will apply to all maps of the same area, regardless of scale. It is accurate; chance of error is reduced to a minimum. It is brief; map point description by radio or telephone reduces transmission time to a minimum.

The major disadvantages of the method are: Each location must be plotted. The accuracy of location is dependent on accuracy of plotting.

This method is primarily valuable to fire control organizations as an emergency or stop-gap method pending the receipt of gridded or subdivided maps.

# RAILROAD FIREFOG

A. B. Everts

*Division of Fire Control, Region 6, U. S. Forest Service*

The problem of keeping railroad beds clear of grass, weeds, ferns, and other flammable material is a vexing one. Not only does such vegetation constitute a fire hazard and hasten tie decay, but in some cases, especially when the railroad undergoes a period of nonuse, it may actually hinder operation by making traction difficult.

This was the situation in which the Puget Sound Pulp and Timber Company of Bellingham, Wash., found itself in the fall of 1949. The company had 35 miles of logging railroad which had not been in use for a year. They also had a bridge to replace. Vegetation across the rails made it difficult for the locomotive to haul material to the bridge site.

At prevailing wage rates, cutting the vegetation by hand would be a slow and costly procedure. Spraying was considered and rejected. How about burning? The problem was put up to Bill Catlow, the company forester. The "machine" that finally evolved was a combination of firefog and a propane-Diesel oil flame thrower, both of which have been previously reported in Fire Control Notes. Bill Cheney, of the W. C. Cheney Manufacturing Company of Seattle, a man with an inclination to try out new ideas, drew up a rough design and company management gave approval. The unit for this large-scale job is shown in figure 1.

*Flame Thrower.*—Eight 2-inch burners were suspended behind a railroad flatcar in such a manner that the flame from four of the burners was brought to bear between the rails. Two burners on each side pointed outside the rails. Since this was the first unit of its kind and considered to be experimental, provisions were made for adjusting the burners as to angle and for raising and lowering the entire assembly.

Four 125-gallon spherical liquid gas tanks of commercial design were mounted on the flatcar. Two of these contained propane and two Diesel oil. If freezing should occur because of the volume of gas being withdrawn, it is possible to shift from one propane tank to the other. By using this type of tank, it is also possible to take advantage of the price saving of bulk delivery of propane.

The four tanks were subjected to a 400-pound hydrostatic test, and the safety release valves were set at 180 pounds. As in the firefog unit and the flame thrower, the propane gas pressurizes the Diesel oil. Not only does this arrangement eliminate the need of a pump, but the propane gas bubbles in the Diesel oil make a hotter flame than Diesel oil alone.

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[1] EVERTS, A. B. FIREFOG UNIT. U. S. Forest Serv. Fire Control Notes 9 (2 and 3): 39-42, illus. 1948.

———PROPANE-DIESEL OIL FLAME THROWER. U. S. Forest Serv. Fire Control Notes 10(1): 30-33, illus. 1949.

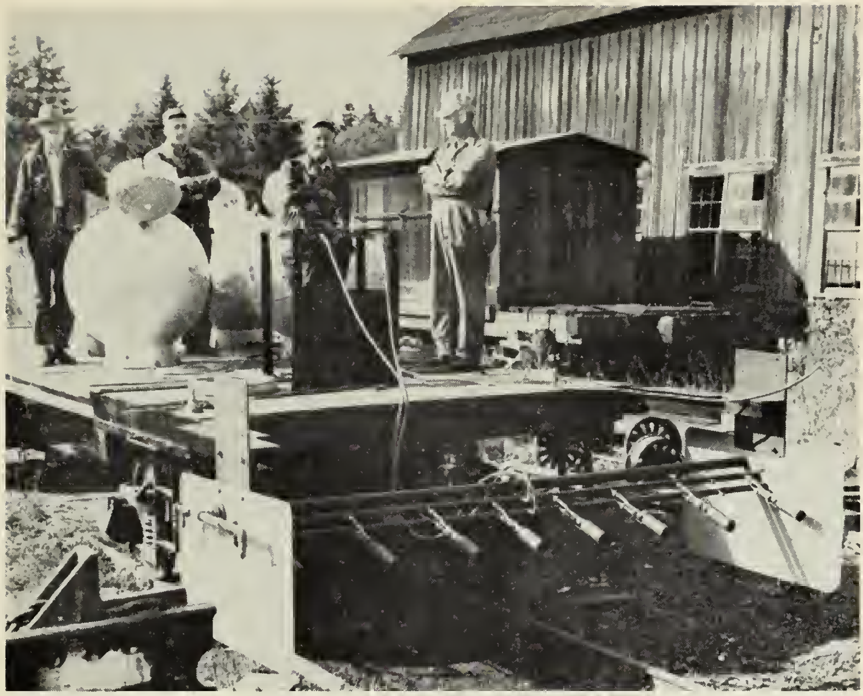


FIGURE 1.—Railroad firefog showing fog plates and tips. The lower 1½-inch pipe carries propane gas; the middle pipe, Diesel oil; and the upper 2-inch pipe, water for the fog tips. The hose connection between the control box and water pipe is not shown.

Once the burners are in operation, except for pressurizing the oil tanks, very little propane gas is used by itself.

*Fog Control.*—Originally it was planned that the vegetation would be burned while it was dry or curing. Thus, some means of confining the fire to the burned strip were necessary. It was thought that this could best be done with water fog. With a 10,000-gallon railroad tank car behind the locomotive and in front of the burning car, conservation of water was not a problem. Two steel fog plates were mounted as shown. On the outboard side of each of these plates two 15-gallon-per-minute fog tips were provided. Thus, a total of 60 gallons of water per minute would be used in control, and the tank car would provide enough water for better than 2 hours and 45 minutes of operation. If less water was needed, one of the fog tips on each side could be turned off, thus doubling the operating time.

Low velocity, homogeneous-type fog tips were used. Normally, these tips produce a 10-foot circular ball fog pattern, but since they are mounted close to the fog plate, the diameter of the fog pattern is cut in half. In other words, 15 gallons of fog per minute would wet down the vegetation for 5 feet on the outboard side of the plates while an additional 15 gallons would strike against the plate and drip off in a heavy concentration.

At this stage, someone is sure to raise the question about the railroad ties catching on fire. It was believed that, for the most part, the blast effect of the burners would so quickly consume the vegetation that temperatures of sufficient intensity and duration to ignite the ties would be lacking. Nevertheless, it was planned to follow behind the burning car with a speeder to put out all fires that did linger in the ties. Because the burner performed beyond expectations, this problem, as will be explained later, did not materialize.

*Controls.*—A box with individual valves for the propane, Diesel oil, and water control was provided for the operator at the burner end of the car. Propane and Diesel oil can be mixed so as to produce the type and intensity of heat that will best do the job.

*Operation.*—When the unit was assembled last October, it was found that the reflected heat was so great that protection was needed for the operator. Accordingly, corrugated sheeting was used to provide this protection (fig. 2).

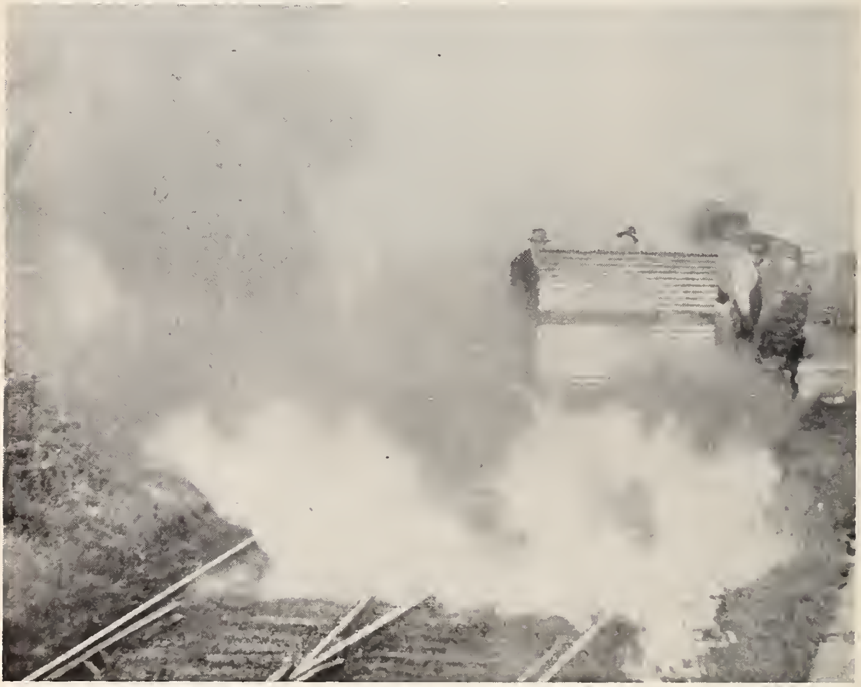


Figure 2.—Railroad burner in operation. Note protection provided for the operator.

It was raining when the unit was ready for test. Even though the vegetation was wet, it was found that the heat was so intense that burning could still be done. Therefore, it was decided that burning would always be done on wet days. Thus, the tie-burning problem was settled and with it the need for fog control, at least in this area of high rainfall. With the thought in mind, however, that other sections of the country might be interested in this railroad burner, the fog control has been included.

In the rain, an estimated speed of 3 miles an hour was obtained. A second pass over the roadbed was made at about 6 miles an hour. Last fall the roadbed was cleared to the site of the washed-out bridge (fig. 3).

This spring, with the bridge repaired, the rest of the roadbed into the logging-operating area was burned.

The fog plates have been removed and in their place 2½-inch burners, one on each side, have been added. These burners, set at 45°, point outward and thus further widen the burned strip. With the fog plates removed, the burner assembly has been lowered much nearer the rails.

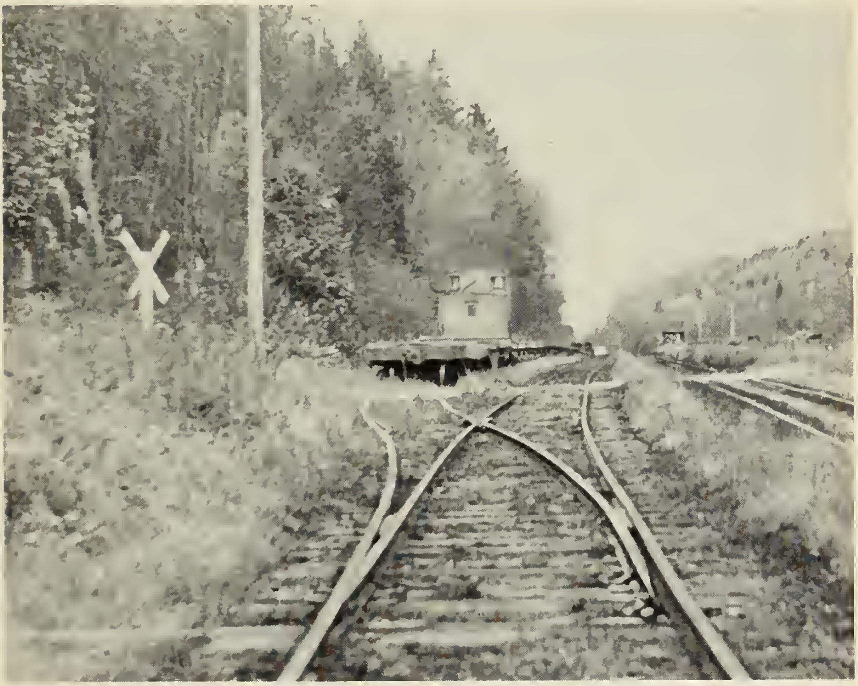


Figure 3.—The roadbed after the burner has passed over. All burning was done in the rain.

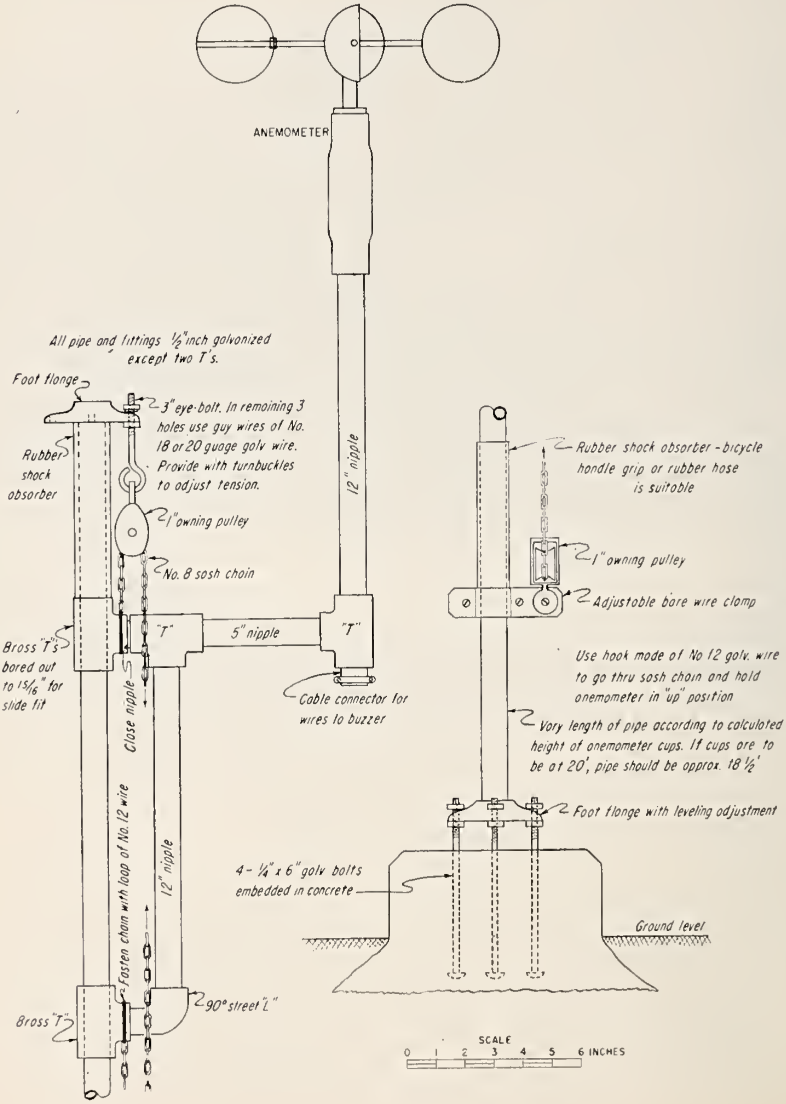
Latest reports indicate that two burnings will be made a year; one in the spring after the grass has had a good start, and again in the fall after it has recovered from the first burning. It is believed these two burnings will keep the roadbed clear of vegetation.

[There is some danger in using propane for pressurizing a liquid fuel tank. Propane gas expelled when liquid fuel tank is refilled is a serious hazard. One fire fighting organization discontinued such use because of the hazard and substituted air pressure.—Ed.]

# HANDY ANEMOMETER MAST

A. W. Lindenmuth, Jr., *Forester, Fire Research, Southeastern Forest Experiment Station,* and J. J. Keetch, *Danger Station Inspector, Region 7, U. S. Forest Service*

For mounting an anemometer approximately 20 to 30 feet above ground level, this design for a mast provides economy, durability, and convenience. One semiskilled worker can set it up using only a pipe wrench, screw


ANEMOMETER
12" nipple
All pipe and fittings ½"inch galvonized except two T's.
Foot flonge
3" eye-bolt. In remoining 3 holes use guy wires of No. 18 or 20 guage golv wire. Provide with turnbuckles to odjust tension.
Rubber shock obsorber
1" owning pulley
No. 8 sosh choin
Bross "T's" bored out to 15/16" for slide fit
"T"
5" nipple
"T"
Cable connector for wires to buzzer
Close nipple
Fasten chain with loop of No. 12 wire
12" nipple
90° street "L"
Bross "T"
Rubber shock obsorber - bicycle hondle grip or rubber hose is suitoble
1" owning pulley
Adjustoble bore wire clomp
Use hook mode of No 12 golv. wire to go thru sosh choin ond hold onemometer in "up" position
Vory length of pipe according to colculoted height of onemometer cups. If cups ore to be ot 20', pipe should be approx. 18 ½'
Foot flonge with leveling odjustment
4 - ¼" x 6" golv bolts embedded in concrete
Ground level
SCALE
0 1 2 3 4 5 6 INCHES

driver, pliers, and standard hardware (except for the small concrete foundation and reamed brass T's). After it is in use, the serviceman will save a lot of time while periodically caring for the instrument because the anemometer can readily be lowered within reach and is easily pulled up to the standard operating height. Total cost[2] for the mast: about $10 for materials plus 2 hours of semiskilled labor.

This equipment has been service-tested and found satisfactory. The figure gives all the necessary erection details, but these few supplemental suggestions are helpful: Use rustproof hardware. One-half-inch pipe is satisfactory for masts up to 21 feet in height. Larger-sized pipe, also larger sliding T's, are recommended for higher masts. A short stepladder is needed when servicing the instrument if the mast is more than 25 feet high.

Plumb the mast. The best way to do this is to screw a 2- or 3-foot piece of pipe into the bottom foot flange: then align this short section with a carpenter's level. Use lightweight guy wires and take up only enough slack to hold the mast erect. If the mast is not plumb or if the guy wires are taut, the mast tends to bow.

## Rest Camps for Large Fires of Long Duration

Due to someone's carelessness, a fire started on the Los Padres National Forest July 5, 1950. The best suppression efforts of the Region were stopped or delayed by a country so steep and rugged that it was impossible to use mechanical equipment to construct fire lines. The cover was tinder dry, with the constant threat of having a fire crew trapped and burned to death. Helicopters were used to transport men and food to high, inaccessible places, while other crews fought their way on foot up the steep, rugged mountains to fight the spread. After a few days of such work, the fire fighters would become exhausted and depressed.

Three weeks after the fire started a separate camp was established away from the turmoil of the main fire camp, where these exhausted men could rest, relax, and recuperate before again being sent back to the fire line. For this purpose, a Forest Service public camp ground was taken over and closed to public use. The camp was on the banks of the Arroyo Seco and had plenty of fine shade, two swimming holes, bathhouse, latrines, and running water. The rest camp had its own kitchen, commissary, and Red Cross set up. The camp ground tables were assembled near the kitchen, so that the men could sit down and enjoy a well-prepared meal. Three meals a day were served. Men coming off the line were checked in at the main fire camp, and then sent to the rest camp, where they bathed, washed their clothes, received medical attention, and rested for 24 hours before being sent back to the fire line. In many cases, it was hard to recognize the clean, fresh men who left the camp as the blackened, exhausted men who had entered 24 hours earlier.

The rest camp took a load off the main fire camp, and assisted in other ways in the management of the fire. The maximum number of men in the camp at any one time was approximately 250. After the fire had been controlled, the camp was used to segregate and assemble the various crews for dispatch to their home forests or cities.

The rest camp is an idea which should be considered for any fire of long duration. All of the forest personnel in the main fire camp gave complete cooperation, and the fire fighters who spent time in the camp thought it a wonderful innovation.—T. R. LITTLEFIELD, *Engineer, Division of Engineering, Region* 5, *U. S. Forest Service.*

# NEBRASKA FIREBREAKS

WILFRED S. DAVIS

*Forester, Region 2, U. S. Forest Service*

Firebreak building was a fairly popular work project in the days of the Civilian Conservation Corps. It enabled the employment of great numbers of men with hand tools and created swaths from which fire suppression forces could make a stand. But lack of maintenance funds made it difficult to keep up these barriers when the CCC was disbanded, and most of the firebreak systems are today abandoned and overgrown.

The Nebraska National Forest, however, is keeping up a system of firebreaks that has been maintained since 1910. Without such a system, it is doubtful if the forest could survive.

This national forest is located in the vast sea of grass-covered dunes known as the Nebraska sand hills. Every tree on some 20,000 acres has been planted. It is a successful attempt to show that a forest can be grown under the somewhat adverse conditions in the sand prairie, and represents one of the largest single afforestation projects in the world (fig. 1).

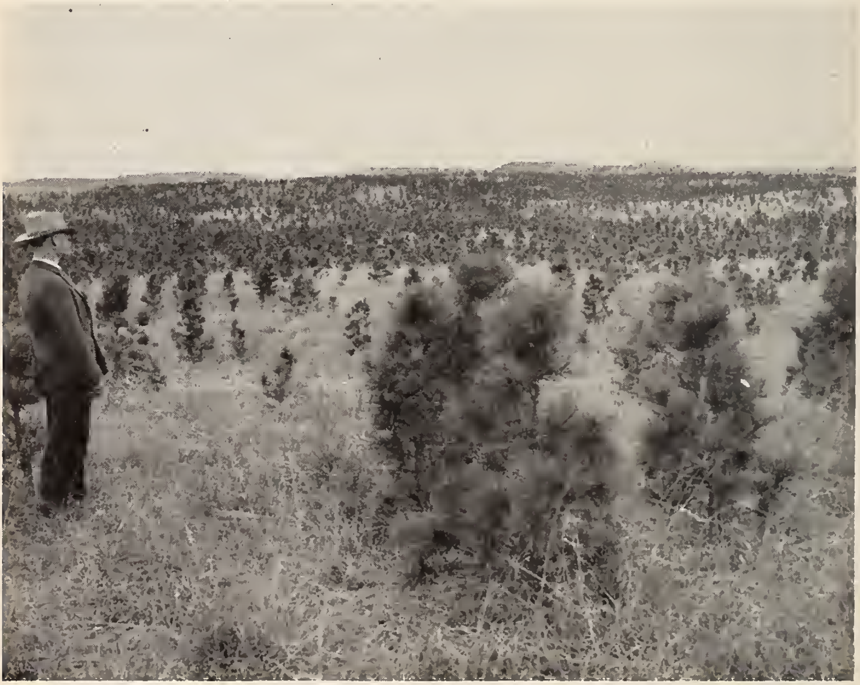


FIGURE 1.—Successful ponderosa pine plantation growing in a flash fuel grass type.

Lightning and man for centuries have caused vast prairie fires to sweep across the sand hills. The chemicals in the ashes gravitated into the major depressions and created potash deposits, which were recovered during World War I and used in the manufacture of explosives. The repeated fires that caused this potash accumulation probably prevented the build-up of surface litter for more than a few years at a time.

When the plantation project was initiated, it was of course necessary to check periodic prairie fires in the afforested area. This soon caused an increase in the grass density between the trees and an accumulation of dry litter, which made it extremely difficult to check fires sweeping in from the outside (fig. 2). Consequently, a system of permanent firebreaks was devised.

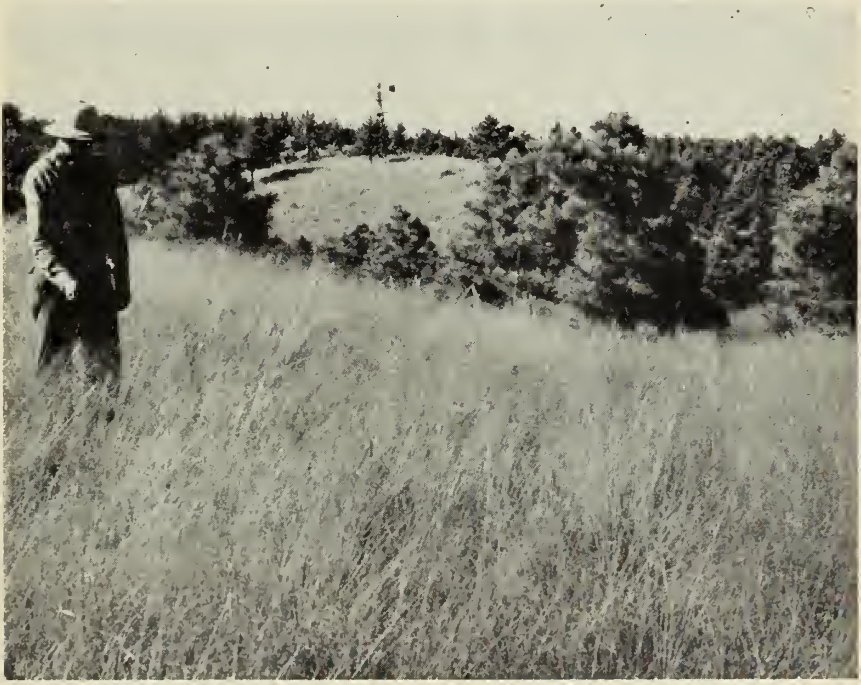


Figure 2.—Dense prairie grass on the edge of a plantation. There is enough litter on the ground to carry fire even when the grass is green. When the grass is cured, it will support fire of high intensity and rate of spread.

The basic concept of the firebreak system was (1) to provide protection against outside fires, and (2) to divide the planted areas into units of less than a square mile, so as to make interior fires easier to handle. Some of the first firebreaks were made relatively narrow; these proved ineffective in high winds, and wide standards were adopted.

The major exterior firebreaks consist of three plowed and disked 20-foot sand strips separated by strips of grass at least 150 feet wide. The sand strips are disked annually, to prevent vegetation from creeping in, and one of the grass strips is burned annually; two year's growth of grass is required for a clean burn.

The interior firebreaks are single lanes of grass edged by disked strips (fig. 3). The grass cover is burned off every other year.

The annual burning of firebreaks takes place in the fall, usually after the first frost has killed the annual growth of grass (fig. 4). A typical burning crew consists of 3 torch men, 2 guards, 1 tanker or tractor driver, and 2 mop-up men. The fire in grass goes out quickly, but mop-up is required for smouldering cow chips and burning soapweed (yucca) plants. The crew soon becomes adept in the use of fire, and learns to employ terrain and wind to the best advantage. Three to five miles can be burned each day when the humidity is sufficiently low (less than 30 percent).

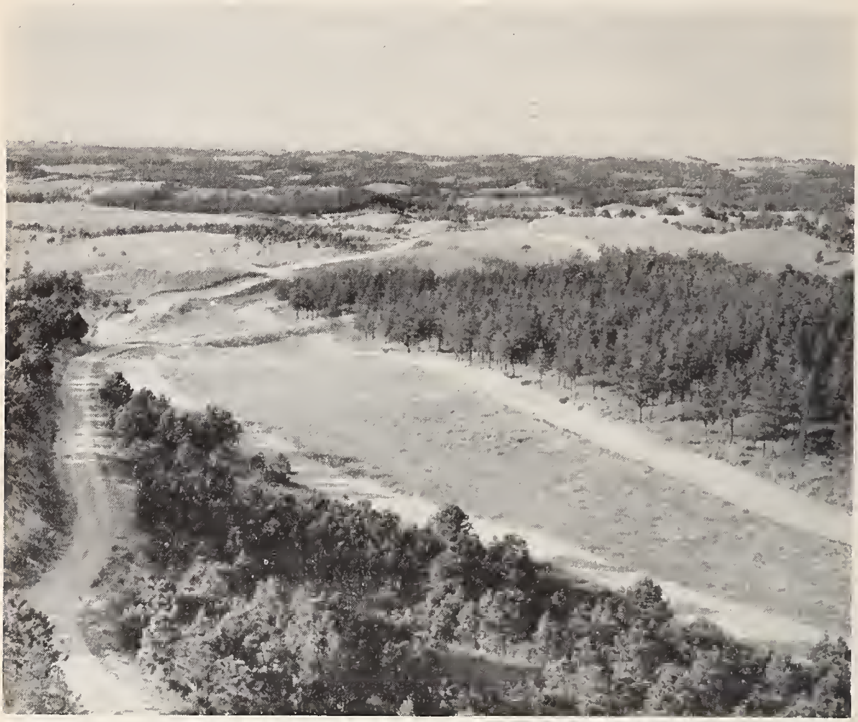


FIGURE 3.—Typical interior firebreak.

The maintenance of the Nebraska firebreak system is a considerable task, involving the disking of 594 miles and the burning of 61½ miles of grass lane annually.

Virtually all of the planted acreage of the Nebraska project was wiped out in the spring of 1910, when a disastrous prairie fire swept through the area. Since the establishment of the firebreak system in that year, however, plantation losses to fire have been small, despite the fact that there have been a number of large "outside" fires. These advance with considerable rapidity; in one instance, a frontal spread of 6 miles in 40 minutes was clocked. However, the planted areas have remained relatively free from fire invasion. Today, some of the older trees ar approaching sawlog size, and natural reproduction is beginning to come in. Thanks to the protection system, of which the firebreak network is a vital part, an afforestation effort extending over nearly a half a century is beginning to bear fruit.

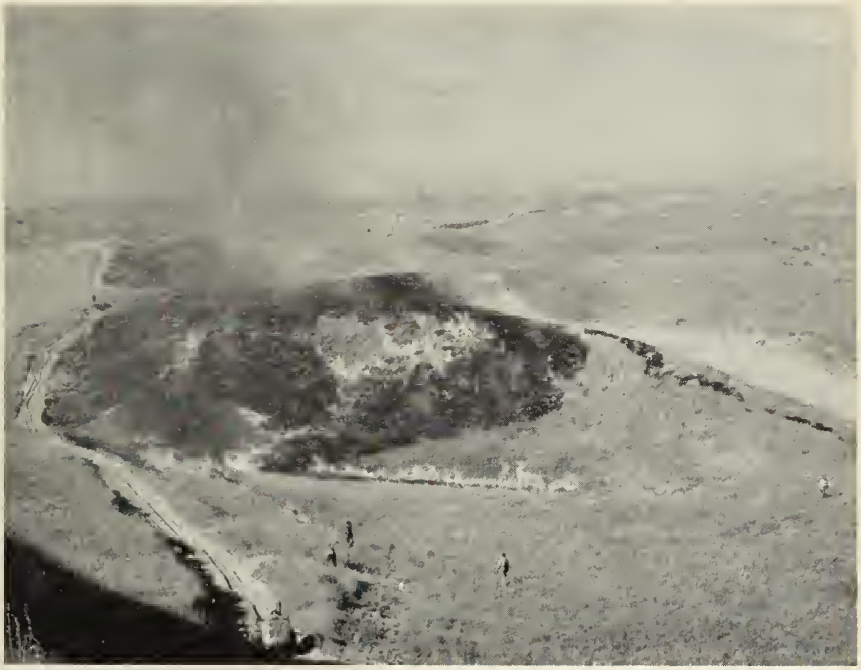


FIGURE 4.—Burning an exterior firebreak in the fall of the year.

## Nonmilitary Aircraft

The following interesting information on all nonmilitary aircraft is a result of a Civil Aeronautics administrative study:

"More than half of the Nation's 92,442 registered civil aircraft are owned in 10 States. California continues to lead the list of States in aircraft ownership with 10,508 planes registered there—11.4 percent of the national total. The other nine leading States, in order, are Texas, Illinois, New York, Michigan, Ohio, Pennsylvania, Kansas, Indiana, and Florida.

"The study reveals that 62,496 of the registered aircraft are 'active,' that is, in general day-to-day use, with 29,946 classified as 'inactive,' although still registered. Of the total fleet, 86,533 are single-engine planes; 4,498 have two engines; 23 three engines; 575 four engines; and 1 eight engines. Of the inactive planes, 311 are classified as 'unspecified' because of the lack of data as to powerplant, model, or other characteristics. None of these has an air-worthiness certificate, and could not be granted one without the required data. In addition there are 469 gliders, 15 lighter-than-air craft, and 17 balloons.

"Ten 'Ford Trimotors,' forerunners of the modern multiengined air transport planes, are still registered as 'active.' They were built in 1928 and 1929."—From *CAA Journal, October* 15, 1950.

# EMPTY CHAIRS IN FOREST SERVICE HOMES

Carl Burgtorf

*District Ranger, Monongahela National Forest*

What do we remember about forest fires? We remember the waste and our loss. We prevent fires in an effort to prevent this loss of human and natural resources. We know that not all fires can be prevented so we plan to meet that risk. Our safety plans are made to reduce or eliminate the loss of personnel in fire control. There are many grim reminders and sobering details of fatalities on the fire line, some of which are buried in the records, while others are burned into the hearts of those who will never forget.

How many empty chairs will fire fatalities leave in our homes in 1951? The year 1949 brought 18 deaths for the U. S. Forest Service directly attributable to fire fighting while 3 others died on fire duty as a result of heart condition. Judging from the 1949 fatality list the stage was set for death to strike 4 men: one, a T. S. I. crew member, was placed under a 140-foot snag which fell in the *unexpected* direction; the second was under a 65-foot snag, hollow and on fire, that also fell in the *unexpected* direction; the third was too close to a hollow snag, burning from top to bottom, that was caught in a gust of wind and fell *unexpectedly;* while the fourth was in a crew attempting to cut a 100-foot snag, which was on fire, with a power saw. 15 feet of the top broke off and fell on its victim.

After reading the reports of these four deaths a natural assumption is that snag felling is dangerous work. The next assumption might be that felling snags of uncertain soundness, hollow or otherwise difficult to handle, involves too much risk and should not be done by the usual felling crew operating at the base of the snag. Wouldn't that be a sound decision after four deaths by this cause in 1949?

How can dangerous snags be felled without cutting them off? Why not dynamite them from a safe distance? Experienced men blast miles of ditch line, etc., each year for the Soil Conservation Service without a fatality, so handling the explosives should be little more difficult than handling and hauling a power saw and gasoline. Certain dough type or packaged units of explosives used by military demolition squads might be far superior to regular dynamite.[1] At any rate the problem to eliminate is the need for men at the base of the snag, setting up vibrations with ax, saw, or other tool, trusting to luck for a safe escape. Why set a stage in which excessive risk is so evident?

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[1] Johnson, G. B. army explosives for hazard reduction. U. S. Forest Serv. Fire Control Notes 8(1): 42-44. 1947. This article describes tests of military explosive used for snag felling. The Northern Pacific Region of the Forest Service at Portland, Oreg., has published some mimeographed material on snag felling with explosives.

Fifteen Forest Servicemen died during 1949 from suffocation or burns. They were trapped by forest fires that changed directions *unexpectedly.* As each of these men was killed, or injured to die later, there were others nearby who made successful escapes. Who can say that fate played a hand in their escape. We can't count on fate to save our men so we must put our faith in a realistic training program.

The success of a safety program rests with the individual worker; accidents happen to individuals and in the final analysis, we might say, each worker rides in a driver's seat where he has the power to follow a clear trail or one beset with accidents. Some individuals are "accident prone." Why? Why does performance vary with different people? The answer is obvious; people are different.

When we consider the qualities which, outside of physical or mental capacities, have decided effect on a workman's performance, we find that as a person is confronted with a certain job, he will perform the work within a pattern. This pattern might easily identify each man's workmanship and is influenced by his inherent *skill,* past experience, and *training* and his *attitude* at the time. You have heard of good working habits, safe practices, safety consciousness, carelessness, thoughtlessness, and if you know your workman you may see these characteristics or notice their absence in his work pattern. How simple your safety job would be if you could hand each employee a "pattern package" containing skill, training and an excellent attitude.

The "pattern package" might seem to be as unrealistic as a flying saucer, and yet you have seen excellent supervisors or foremen develop skillful trained workmen with fine attitudes. Of course, these workers did not acquire their work pattern overnight. Trial and error, success and failure, practice with actual performance and thoughtful guidance each had its part in forming this pattern. The trained and skillful foreman in charge of the training program knew what he wanted his workmen to be like. He knew what pattern of performance he wanted from his outfit and he got that pattern by developing the skill, training, and attitudes of his men. The foreman had acquired a personal knowledge of what constitutes a pattern for workmen. Call it a standard of performance if you will, but each man's pattern must fit the standard in the final analysis. Each man must have skill, training, and a good attitude if he is to be consistent in quantity and quality of output.

What has all this to do with fire control? It reaches to the very grass roots of personnel management; it concerns the man driving the tractor, the man on the fire line, the straw boss, the foreman, in other words—the individual. It has usaully been some individual failure that put on the straw to break the camel's back. Seldom has equipment been directly responsible for accidents and in those rare cases it is usually found that some person through carelessness (attitude) permitted his equipment to become involved in situations which demanded results beyond the capacity to produce. "The brakes failed to hold," is frequently read in accident accounts. Most brakes fail to hold when the wheels are off the ground!

A recent Forest Service report indicated that the five chief causes of human failure in accident occurrence have been fatigue, haste, inadequate supervision, faulty instruction, and lack of attention or improper attitude. Fatigue, haste, and improper attitude are factors of direct individual behavior, but inadequate supervision and faulty instruction are the responsibilities of leadership. These causes of human failure have resulted in many deaths.

As supervisors of men we can attack weak points in our organizational set-up. Most of us do. We think about the safety of our men frequently and write reports and prepare records for distribution and filing. We have beautiful records—of accidents. Yet, how frequently do we find ourselves attacking the symptoms instead of the disease. We think of fatigue and haste, two allies of the grim reaper, and we know that few men go to a forest fire who do not, at some time, get tired, or act in haste—it is that kind of a job. Fire fighters work hard and hurry. They must. Will it do any good to tell them not to get tired or not to act in haste?

Let's refer to that "pattern package" mentioned before. Will we be attacking the disease instead of the symptoms if we give each man a good dose of skill and training and check him for attitude?

Some of our leaders may have been taught to memorize such phrases as "be careful" or "don't do this or that." How much better we would feel if we could step up to each leader, or foreman, and say, "Joe, you have been given skill enough and training enough, and have proved yourself as a leader. You have been taught how to check each job and plan accomplishments in advance. When you 'feel' that too much risk is involved in a situation, after you have checked carefully, take heed—that will be your experience, your training, and your skill telling you that an accident is just around the corner. That 'feel' or pattern of experienced reaction saved the lives of several men last year, Joe."

How many empty chairs in our homes this year will be due to the unexpected?

## INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphis breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed in the manuscript immediately following the paragraph in which the illustration is first mentioned, the legend being separated from the text by lines both above the below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

When Forest Service photographs are submitted, the negative number should be indicated with the legend to aid in later identification of the illustrations. When pictures do not carry Forest Service numbers, the source of the picture should be given, so that the negative may be located if it is desired. Do not submit copyrighted pictures, or photographs from commercial photographers on which a credit line is required.

India ink line drawings will reproduce properly, but no prints (black-line prints or blueprints) will give clear reproduction. Please therefore submit well-drawn tracings instead of prints.

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# FIRE CONTROL NOTES

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Volume 12 Number 2

# FIRE CONTROL NOTES

## A Quarterly Periodical Devoted to the
## TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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# HELICOPTER USE FOR FIRE CONTROL ON THE WALLOWA FOREST

Gerald J. Tucker, *District Ranger,* and John B. Smith, *Fire Control Staff Officer, Wallowa National Forest*

Helicopters were used at various times during the 1949 and 1950 fire seasons for transporting men and equipment to forest fires on the Wallowa National Forest. Use of this type of aircraft to date has been confined to the very rugged terrain of the Imnaha River canyon and in the spectacular Hells Canyon of the Snake River.

The Imnaha, a tributary of the Snake River, runs parallel to the Snake for 50 miles at distances ranging from 6 to 18 miles. The country between the two rivers is a land of rugged canyons, precipitous slopes, and great rims or bluffs. A road extends along the Imnaha River and connects with a highway to the forest supervisor's headquarters at Enterprise, Oreg. A one-way forest road extends for 24 miles from the Imnaha road to Hat Point lookout, which is located near the center of this area; there are no other roads.

The Wallowa Forest has an airplane landing field located at Memaloose, near the end of the Hat Point road (fig. 1). This landing strip is 60 miles from Enterprise and travel time required is about 3 hours by car, 4 hours by truck, or 20 minutes by airplane. The forest has another airplane landing strip at Lord Flat, 20 miles north of Memaloose, which has no road connections. There are few good trails, and travel by trail or cross country is slow and sometimes dangerous or impossible. It is frequently necessary to travel 5 to 10 miles to reach a point only a mile or two distant. The area is covered with fuels that are generally flashy with high or extreme rate of spread.

Experience indicates that the helicopter is well adapted for use in this roadless area where elevations range from 1,200 to 7,000 feet. Although most of the area has very steep slopes, there are numerous open ridge tops and flat benches which make excellent landing spots for the helicopter.

Commercial helicopters from Yakima, Wash., were used in 1949 and from Missoula, Mont., in 1950. All were two-place Bell machines and were usually able to carry a fireman pack or other equipment up to 50 pounds in weight in addition to the pilot and one passenger, the amount of freight depending upon the weight of the passenger. The machine from Missoula was equipped with a wire basket cargo carrier mounted on the side, which makes a convenient and practical means of hauling cargo and can be used for transporting an injured person.

Base camps from which to operate the helicopters were established at some point along the roads or at the Memaloose landing field, and elevations of these bases ranged from 3,000 feet at the Colvin Ranch to 6,700 feet at Memaloose.

Use of the machines is somewhat marginal at the higher elevations during the middle of the day. However, they were used at all times needed

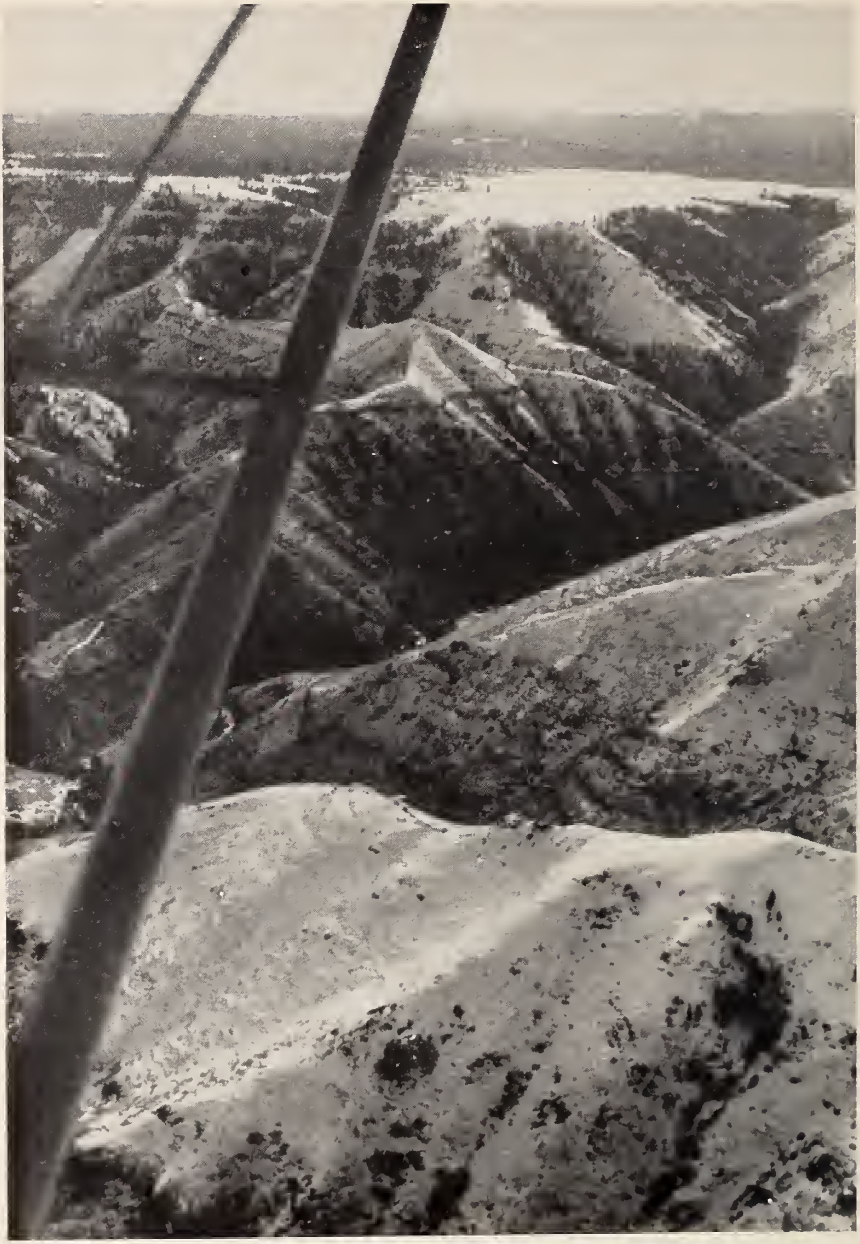


Figure 1.—Typical canyon country of the western Wallowas. Memaloose airstrip, upper right; elevation, 6,700 feet.

except for a short time one afternoon during a period of considerable air turbulence. During this afternoon, while the helicopter was grounded, a small fire started. Two firemen with horses were started over the 10½ miles to the fire. Some 30 minutes later the helicopter pilot, after making a trial flight, decided that it was safe to carry men, and in 42 minutes he had placed two firemen on a ridge top 300 yards from the fire. One fireman had been taken from the base camp, and the second was picked up at a lookout-fireman station some 10 miles from the base camp. The horseback firemen arrived 3 hours later, after the fire was under control.

On August 3, 1950, Ranger Tucker and two firemen enroute to another fire discovered the Black Butte fire in Hells Canyon. This fire was in a blind area not seen by lookouts, but since it was in flashy fuel and potentially most dangerous, they went at once to it. It was soon evident that more help would be needed, and a yellow streamer signal was placed for the patrol plane which had previously been requested to scout the area. A Motorola handi-talkie was dropped to Tucker and he ordered men and equipment.

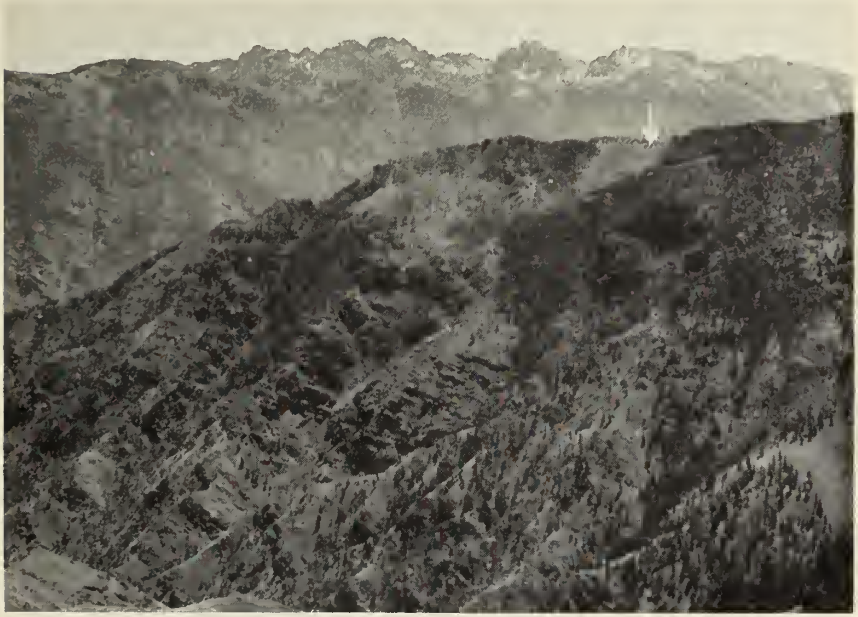


Figure 2.—Arrow indicates where helicopter landed fire fighters on the Black Butte fire. Smoke jumpers also landed on this ridge. Fire was still 1½ hours walking time from this point.

At 6:00 p.m. seven men left the road near the Memaloose airfield to walk to the fire, about 5 miles airline distance, but 7 miles by trail and 7 miles across country. They stopped enroute from 10:00 p.m. August 3 to 4:00 a.m. August 4 because night travelling was hazardous. They took the wrong ridge in walking down to the fire from Black Butte and came out on a ridge across a deep precipitous ravine from the fire. However, they were within speaking distance, and, following shouted instructions from Ranger Tucker, they were able to make their way through the rims in about an hour to the fire. They arrived tired out at 9:00 a.m. It took them 9 hours walking time to get to the fire.

Fourteen smoke jumpers, six from Region 6 and eight from Region 4, were used on this fire. They jumped near Black Butte on a timbered slope and walked about 3 miles to the fire. Two arrived at the fire at 9:00 p.m. August 3, and the rest jumped early the next morning.

A helicopter from Missoula operating from Memaloose airfield ferried 14 local men to a flat ridge top near Black Butte, which was about 1½ hours walking time from the fire and near where the jumpers landed (fig. 2). Airline distance for the helicopter was about 5 miles, and a round trip, including loading and unloading, required 9 minutes. Six men, who were flown by airplane from Enterprise to Memaloose and by helicopter to Black Butte and took 1½ hours walking time, had only 3 hours travel time from point of hire to arrival at the fire.

The fire crew was supplied by air drop from a local airplane under contract, and William Maxwell, clerk on the Imnaha-Snake Ranger District, did the dropping.

Because of the desirability of quickly returning the smoke jumpers to their base, they were ferried by helicopter from the fire to the Memaloose airfield. Seventeen other men were also ferried to the Memaloose airfield, but three of the local men preferred to take the long walk out. Most men, although hesitant to make the first trip, soon enjoy riding in the helicopter, and there has been no air sickness reported here from air travel in this machine.

We believe the helicopter to be a practical answer for transporting men to fires in the canyon country of the Snake and Imnaha Rivers and that both time and money are saved by the judicious use of this machine. Although we have had two near misses on accidents, we believe that, as the pilots get more mountain-wise and the machines improve, they are destined to play a more important part in fire control work.

## Rust Preventive for Water Tanks

An experimental test of a commercial compound to prevent rust was recently conducted at the Michigan Forest Fire Experiment Station, Roscommon, Mich.

The results of the test would appear to have ended a long-time search for a satisfactory and economical rust preventive that could be used in the water carried or stored in fire equipment water tanks. The trade name of the material tested is "Banox."

Four small tanks made of 14-gauge, four-way floor plate (mild steel) were used in the test. One part of each tank was coated with Neutrol or Inertrol. Another part was coated with aluminum paint, and a control part was left untreated. Submerged in each tank was an equal amount of scrap steel, iron, brass, aluminum, galvanized iron, bronze, natural rubber, and Neoprene rubber.

Tank 1 contained plain tap water untreated (control tank); tank 2 contained tap water with 2-percent Drench and Banox; tank 3 contained tap water and 2-percent Drench; and tank 4 contained tap water and Banox (in recommended quantity).

Results of tests after 45 days were as follows: Inertrol coating, no damage in any tank; aluminum paint coating, no damage tanks 2 and 4, tank 1 rusted through, tank 3 large spots of rust; untreated iron section, no rust or damage in tanks 2 and 4, tanks 1 and 3 badly rusted. Heavy rusting and metal corrosion occurred in tanks 1 and 3 which had no Banox added to the water. Rusting occurred in tank 3 within the first 24 hours and in tank 1 within 48 hours.

Banox can be used for other purposes such as standby metal water barrels filled with heavy salt water concentrations. It is nontoxic and contains no acids, alkalies, or chromate. Two pounds is enough to treat 200 gallons of water. Cost is approximately $12 for one case of 12 2-pound cannisters, f.o.b. Pittsburgh. [From "Give 'N Take," a leaflet published by the Fire Equipment Development Committee for the North Central States.]—E. E. Aamodt, *Engineer, Region 9, U. S. Forest Service.*

# FIRE LINE FEEDING BY HELICOPTER

Carl C. Wilson

*Assistant Fire Control Officer, Angeles National Forest*

The increased use of the helicopter on forest fires brought the demand for a small vacuum container to transport hot food to workers on the fire line. Through a local war surplus dealer the Angeles National Forest obtained a U. S. Army Air Force "vacuum vat" which, we believe, solves the problem.

This vacuum vat is actually a large thermos bottle with a wide-mouthed opening. It is all metal and will withstand considerable rough use, thus permitting dropping by helicopter at locations where the ship cannot safely land.

The unit, which has been purchased locally for approximately $15, has the following specifications:

| | | | |
|---|---|---|---|
| Over-all height | 18 inches | Weight, empty | 37½ pounds |
| Outside diameter | 16 inches | Weight, with pans | 45 pounds |
| Inside diameter (mouth) | 13 inches | Contents, liquid measure | 8 gallons |

The vat may be obtained with either a stainless steel or enamel lining. The enamel lining, however, permits the transport of citrus fruit juices or other acidic foods without affecting the taste. A set of three tinned pans may be secured with the unit (fig. 1). These are equipped with hold-

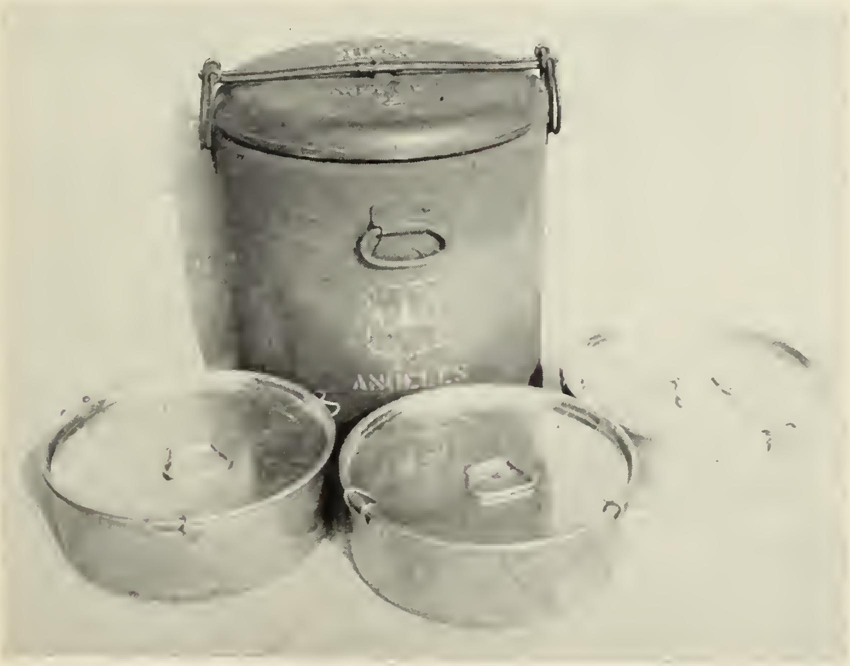


FIGURE 1.—Vacuum vat with three tinned pans. F-463453

down clamps and a lid with handle. Each pan has a 2-gallon liquid capacity. Stacked in the vat the pans provide room for three varieties of hot food.

Best results are obtained if the vat is preheated by filling the thermos unit with boiling water and allowing it to set for 20 to 30 minutes. The pans may be used to cook the food. However, these units will probably last longer if ordinary cooking utensils are used. The hot food is then transferred to the oven-warmed pans, and these are inserted into the preheated container.

Field tests conducted on this forest in May 1948 revealed that the heat loss between the time the hot foods are placed in the vacuum container and when they are served to the crews a reasonable time later was almost negligible.

In one case a 20-man road crew was fed the following menu on the job: Spaghetti and meat balls, string beans, hot french rolls, coffee, and lemonade. The temperature of the spaghetti dish was 142°F. when removed from the oven and placed in the vacuum vat at 10:30 a.m. One hour and 40 minutes later the heat loss had amounted to only 4°. Coffee was placed in the thermos vat at 170°F. at 10:30 a.m., and the temperature at 12:10 p.m. was 160°. Heat loss for the other hot foods was consistently low. The lemonade in the enamel-lined vat, of course, remained cool.

A typical meal which can easily be served by means of the vacuum vat is one tray of stew, one tray of cooked vegetable, and a third tray of hot, buttered rolls. Coffee can either be stored in the vacuum vat or in 1- or 5-gallon thermos jugs. The meal is served on moisture resistant paper plates and eaten with paper or plastic disposable utensils.

Most any hot food can be served from this container. However, foods with a high moisture content tend to lose heat in storage. Examples of commonly used menus are:

(1) Weiners and beans
Stewed tomatoes
Hot rolls
(2) Swiss steak and gravy
Scalloped potatoes
Canned peas
(3) Ham and eggs
Buttered toast
(4) Scrambled eggs
Hot cereal
Buttered toast

In addition, this container can also be used to serve cold lunches. Prepared sandwiches, green salad, and a thermos jug of cold milk or fruit juice makes an excellent noon meal for fire fighters.

If two trays are used for hot food and the third for rolls, at least 15 men can be fed from one container. Twenty men can be fed from one unit if all three trays are used for hot food. Several loaves of bread and some butter can be delivered by helicopter to supplement the three tins of hot food in the vacuum vat.

To eliminate premature opening of the vats when several are brought to a large crew, each should be marked with a tag showing its contents. If possible, all of the crew should be fed at the same time so as to reduce the loss of heat caused by opening and reopening the container.

The key points to remember in using these containers are: (1) Preheat the container with boiling water; (2) heat loss occurs every time the lid is removed; (3) heat loss is less from foods with a high moisture content.

Hot food carried in these vacuum containers was first served to workers on the Echo fire line on the Angeles in July 1948. Food was prepared at Arcadia, trucked to the helispot at the road end, 6 miles away, and then flown to the fire line by helicopter, an airline distance of 1 mile and a vertical rise of 1,600 feet. Travel time amounted to 2 minutes as compared to about 1 hour for foot travel from the end of the road. Hot dinners and breakfasts were available to 55 men on the line in less than 22 minutes after the food left the cook stove in the Arcadia barracks.

Hot food readily available by helicopter makes for better morale among the men and increases line production. These modern tools also will tend to decrease the number of elaborate spike camps with the usual primitive, labor-consuming equipment and the temptation to camp at the water holes which may be some distance from the active perimeter of the fire.

The vacuum vat is an effective tool in getting hot food to crews on isolated sections of the fire line. Heat loss from food in the container is almost negligible up to 1½ hours under normal summer conditions which means that surface transport could be used to carry the hot food in some instances. The success of this unit on fires indicates that it can also be used in other fields of forest management, such as road projects and rescue missions.

## Published Material of Interest To Fire Control Men

*Analytical Studies in the Suppression of Wood Fires,* by George J. Tauke and Ray L. Stoker, University of California, Los Angeles 25, Calif. A paper presented at the 1950 Annual Meeting of American Society of Mechanical Engineers. Published November 1950.

*Chemical Sprays for Protection Roads,* by V. L. Morrison. Journal of Forestry, June 1950.

*Control of Damaging Agents; Fire; Lightning,* sections of a chapter in Management of Ponderosa Pine in the Southwest by G. A. Pearson, Southwestern Forest and Range Experiment Station. U. S. Dept. Agr. Monog. 6. 1950.

*Cooperating for Forest Fire Protection,* by P. H. Merrill. State Government, May 1950.

*Cooperative Fire Prevention Campaigns,* by C. Davis. Forest Farmer, June 1950.

*Crew and Camp Organization on the Actual Fire Line,* by A. A. Boyle. Pulp and Paper Magazine, Canada, May 1950.

*Evolution of the Fire Danger Meter,* by A. Peffer. American Forests, April 1950.

*Fire Protection Law Enforcement Trends in California,* by R. O. Reynolds, Journal of Forestry, October 1950.

1949 *Forest Fires and Fire Danger in Massachusetts, Pennsylvania, New Jersey, Rhode Island, New Hampshire, Vermont, Connecticut, New York, Virginia, Maine, Maryland, West Virginia, Kentucky.* By A. W. Lindenmuth, Jr., and J. J. Keetch. Published separately for each state by U. S. Forest Service, Southeastern Forest Experiment Station, Ashville, N. C., October 1950.

*Forest Fires and the Danger Index in New Brunswick,* by H. W. Beall. Forestry Chronicle, June 1950.

*Forest Fire Detection by Airplane Exclusively,* by C. H. Lewis, Jr., South. Lumberman, June 1, 1950.

*Forest Fire Facts Surveyed.* Canadian Forestry Association. Pulp and Paper Magazine, Canada, May 1950.

*Forest Fire Insurance,* by W. G. Wright. Journal of Forestry, August 1950.

*Forest Fire Protection—Manitoba,* by D. M. Stephens. Pulp and Paper Magazine, Canada, May 1950.

1949 *Forest Fire Statistics.* U. S. Forest Service, Washington, 1950.

*Forest Protection in Quebec,* by H. Kieffer. Pulp and Paper Magazine, Canada, May 1950.

*Further Discussion Concerning Forest Fire Insurance,* by W. G. Wright. Timber, Canada, June 1950.

*Game Wardens and Forest Fires,* by R. L. Williams. Wyoming Wild Life, April 1950.

*Highway Hazard Reduction Guide,* lithographed illustrated booklet by California Region, U. S. Forest Service, in collaboration with State of California, Divisions of Forestry and Highways. April 1950.

*History of Forest Fires in the South,* by F. Heyward, Jr. Forest Farmer, June 1950.

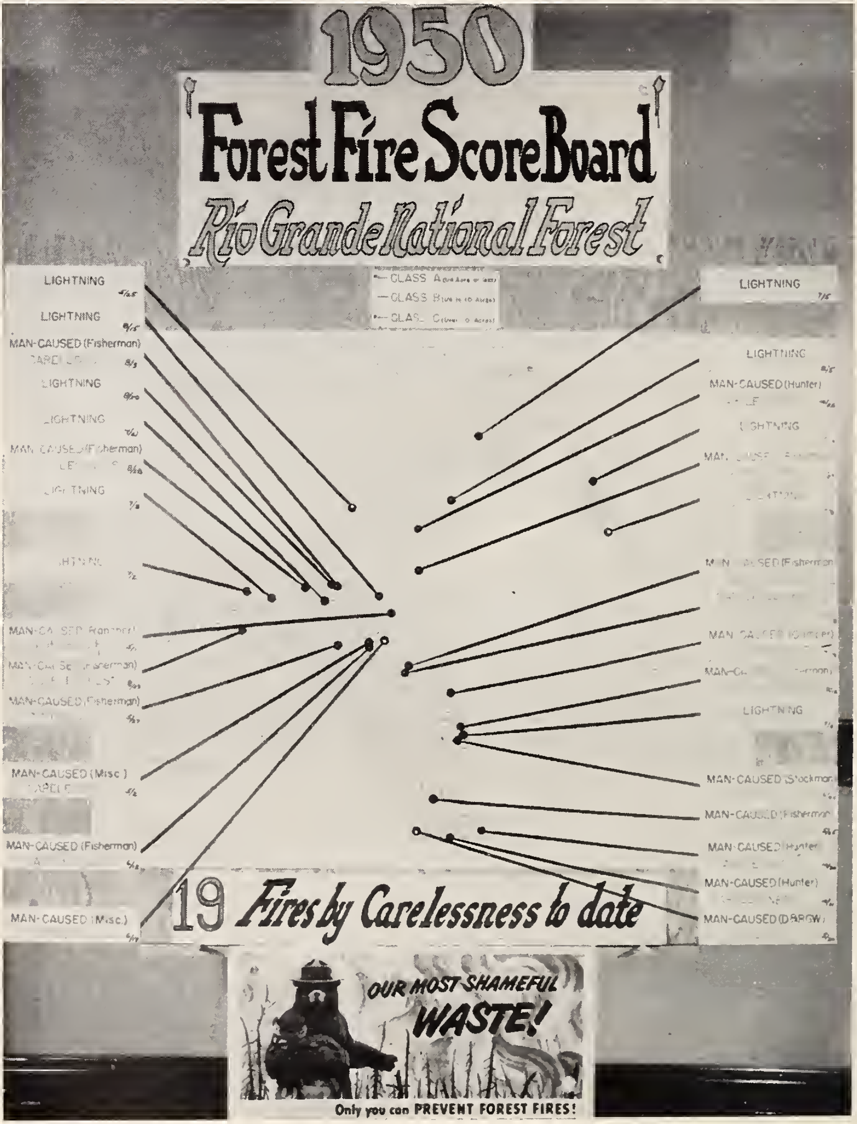
(*Continued on page* 28)

# FOREST FIRE SCOREBOARD

John C. Baird

*Assistant Forest Supervisor, Rio Grande National Forest*

Public interest in fire prevention was stimulated by a scoreboard graphically portraying forest fire occurrence from day to day, which was put on public display throughout the fire season by the Rio Grande National Forest.



The scoreboard consisted of a base map upon which each fire was located by a ½-inch bright red circle. Round-headed pins of different colors to indicate the size class of fires fastened a red ribbon at the fire location. This ribbon led to a card at the side of the scoreboard on which was shown the cause of the fire, class of people responsible, and date of fire.

The theme CARELESSNESS was stressed for all man-caused fires, the word being printed in red letters. A block at the bottom of the board recorded the number of fires by carelessness to date.

The scoreboard was originally used during the annual Sky-Hi Stampede at Monte Vista, Colo., when two identical exhibits of the board were placed in well-located store windows. One scoreboard was maintained at the U. S. Post Office in Monte Vista throughout the entire fire season. Ambrose Burkhart, Senior Clerk on the Rio Grande National Forest, was largely responsible for the exhibit and the work connected with it.

The scoreboard has been instrumental in creating considerable local public interest in fire prevention. An estimated 25,000 people saw the scoreboard during the 1950 fire season, and many expressed surprise at the number of fires and the carelessness involved.

[The forest fire scoreboard described here is considered an excellent forest fire prevention aid. It contains the necessary elements to arouse public interest. Units where a majority of fires result from carelessness will find this method of presentation valuable in keeping the public informed on the local forest fire situation.—Ed.]

## Identification Marking for Tractors

On large fires where a number of bulldozers are working in the same general vicinity, it is often difficult for the cat boss, aerial observers, and others to identify the various pieces of equipment. This is particularly true when both Forest Service and contract equipment are involved, and the latter is owned by several different concerns.

It seems that better control of machines would be possible if each carried a distinguishing letter or number which would be easily read for a reasonable distance, either on the ground or from the air. When the equipment arrives on the fire, it could be assigned a letter or number, if it is not already adequately marked. Water base paint which could later be washed off, or black scotch tape 1 inch or more in width would be suitable for such marking. A roll of tape could be included in fire kits.—C. D. JACKSON, *Topographic Engineer, Region 5, U. S. Forest Service.*

## Study of Portable Wood Chipper

The possible use of a portable wood chipper for fire hazard reduction work was discussed by Ed Ritter in Mechanical Fire Hazard Reducer, FIRE CONTROL NOTES, April 1950. Since that time the Northeastern Forest Experiment Station and the Connecticut State Park and Forest Commission have made a cooperative study of this equipment. The results of the study are published as Station Paper Number 37 entitled "A Pilot Study of a Portable Wood Chipper" by R. H. Fenton and H. A. McKusick. It was found the chipper could be operated (including depreciation) for $4.04 per hour. Production was approximately 195 cubic feet of chips per hour. Costs per 100 cubic feet varied from $1.77 to $2.45 depending upon size of chips produced. The full report can be secured from the Northeastern Forest Experiment Station, Upper Darby, Pa.—M. M. NELSON, *Division of Fire Control, Washington Office, U. S. Forest Service.*

# BULLDOZERS FOR FIRE SUPPRESSION IN THE MOUNTAINOUS TERRAIN OF THE NORTHERN ROCKY MOUNTAIN REGION

Fred I. Stilling

*Assistant Chief, Fire Control, Region 1, U. S. Forest Service*

A plan of standard operating procedures for bulldozer operation in fire line construction has been developed for use in the Northern Rocky Mountain Region. The organization, procedures, and equipment set-up were based primarily on use in timbered and mountainous terrain. The same principles, however, should apply in most cases where bulldozers are used to construct fire line. The operation, as presented, will not always be possible because necessary equipment and skilled personnel are not always readily available. In such cases it is necessary, of course, to make the best use of the available resources and organize accordingly.

The plan presented here is intended to cover only the use of dozers in fire line construction and mop-up. The production figures presented for bulldozer fire line construction are not considered entirely reliable, but they are the best available at present. [1] Region 1 is now using a special form to record additional information on bulldozer fire suppression use and accomplishments.

Following is the plan of standard operating procedure as now used by Region 1 in mountainous terrain:

## ADMINISTRATION

### PLANNING

The use of dozers for fire line construction should be made an integral part of the over-all fire suppression plan.

### SUPERVISION

***Dispatching***

*Know dozer areas.*—The best available map should be used as a base for showing the areas in which dozers can be used.

*Know location of available dozers.*—This means all dozers within your area that can be made available for fire use. The following information should be listed for each dozer and kept up to date:

1. Make, model, and size of tractor.
2. Type of dozer attachment (angle or straight blade).
3. Does it have a heavy-duty winch?
4. Is it equipped with protector cab?
5. Available skilled personnel to operate dozers.
    a. Dozer foreman.
    b. Dozer operators.
    c. Dozer helpers.

*Location of trucks for hauling dozers.*—Kind and size.

*Know road limitations.*—1. Transportation map should show types of vehicles each road will handle. 2. Bottlenecks such as poor bridges, sharp curves, narrow sections of road, etc., should be clearly marked on transportation map.

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[1] Fire Control men using tractors for fire line construction may be interested in reviewing Equipment Development Report Number 13. "Comparative Performance of D-6 and D-7 Caterpillar Tractors Equipped with Hydraulic Angle Dozers". by Region 5, Arcadia Equipment Development Center, April 1948, published by U. S. Forest Service, Washington 25, D. C.

*Flagmen.*—Furnish when possible or when State law requires. This should serve the following purposes: 1. Safety factor. 2. Speed up travel time. 3. Lead flagman should serve as guide.

*Mechanic.*—1. Arrange for as soon as posisble. 2. In addition to regular tools, a portable electric welder is desirable.

*Supplemental equipment.*—1. Torches for burning out dozer line. 2. Water (may be available at site of fire). 3. Diesel fuel, gasoline, and oil. 4. Standard equipment for fire dozer (see "Equipment").

*Know estimated travel time.*—The following is a guide to be used for average equipment, operators, and conditions. These figures should be adjusted to fit known conditions.

1. Transports: a. Highways, mountain—20 miles per hour. b. Side roads, single track—8 miles per hour.
2. Roading bulldozer: a. On dirt road—4 miles per hour, including stops for greasing. b. Cross country—1 mile per hour.

*Fire line production figures.*—The following figures, based upon the estimates by our most experienced men, are for line construction only, according to fuel type resistance to control, and do not include line holding or mop-up.

| | *Line production (chains)* |
|---|---|
| Low resistance to control: | |
| 100-man crew for 10 daylight hours | [1]300 |
| 2 dozers, D-4 or larger, for 10 daylight hours | 500 |
| Medium resistance to control: | |
| 100-man crew for 10 daylight hours | [1]150 |
| 2 dozers, D-7 or larger, for 10 daylight hours | 175 |
| 2 dozers, D-6, for 10 daylight hours | 125 |
| High resistance to control: | |
| 100-man crew for 10 daylight hours | [1]50 |
| 2 dozers, D-8 or larger, for 10 daylight hours | 75 |
| Extreme resistance to control: | |
| 100-man crew for 10 daylight hours | [1]20 |
| 2 dozers, D-8 or larger, for 10 daylight hours | 40 |

[1] Based on pick-up fire fighters.

*General.*—Consider the use of dozers when a fire gets beyond the smokechaser stage if it is located in dozer area. However, remember it is just another tool to be used in fire line construction under certain prescribed conditions.

The availability of adequate crews without dozers versus crews with dozers and the time required to get them on the fire must be considered in placing orders.

Do not dispatch large trucks over questionable roads. This can result in blocking all transportation for several hours.

Remember, a dozer is ready to go to work upon arrival on a fire, no matter how long or tough the trip, provided it is properly serviced and fueled and relief operators are available.

When possible, hire dozers with protector cabs, heavy-duty winches, and angle dozers.

### *Inspection*

1. Does the dispatcher have all the essential information to do an intelligent job of dispatching dozers to going fires?
2. Is the dozer and transport record, showing location, availability, etc., kept up currently?
3. Have dozers been dispatched and used on crew-size fires in dozer areas?
    a. If not, what is the reason?
    b. Where used; was such use effective?
    c. Was the Safety Code followed?
4. Was the line burned out and cleaned up as soon as possible?
5. Were adequate fuel and supplies kept on hand?
6. Were relief operators arranged for where needed?

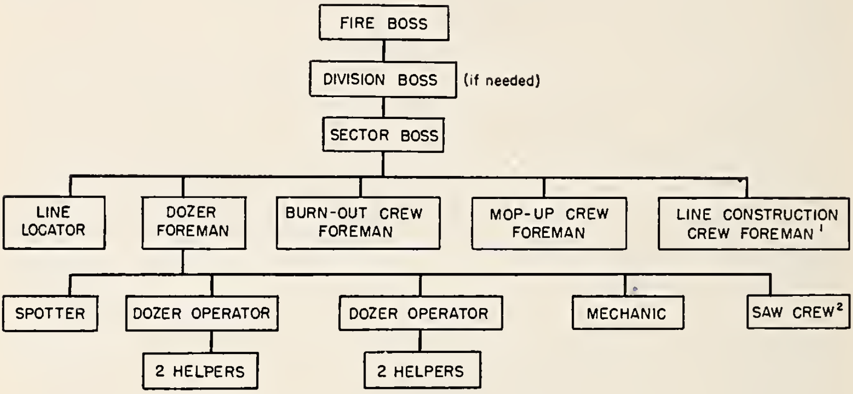
### *Costs*

After calculating manpower and equipment needs to control the fire within allowable time limits, place your order accordingly. Do not duplicate line construction organization by ordering both dozers and crewmen. This has been done all too often in the past. The result is that in some cases the use of equipment has increased the cost of fire suppression without materially improving the performance. Adequate crews for burning out, line holding, and mop-up are, of course, essential for successful use of dozers.

Be reasonably sure that equipment can be used to advantage when it arrives at fire. Release equipment just as soon as it can no longer be used effectively.

### *Crew Organization*

Crew organization is diagrammed in figure 1, and crew line-up on a fire in figure 2.



[1] For constructing hand line if necessary.

[2] Saw crew ahead of dozers if dozers are too small to handle full-length logs.

FIGURE 1.—Crew organization.

### *Communication*

A complete communication network is a must on all large fires. Handie-talkies should be furnished the following dozer sector personnel:

a. Sector boss.
b. Line locator.
c. Dozer foreman.
d. Burn-out foreman.
e. Mop-up foreman.

## PERSONNEL AND QUALIFICATIONS

### *Sector Boss*

1. Good fireman.
2. Good organizer.
3. General knowledge of dozers.

### *Line Locator*

1. Good knowledge of fire behavior.
2. Good working knowledge of the use of dozers on fire line construction.
3. Good woodsman.
4. Good hiker.

### *Dozer Foreman*

1. Good fire foreman.
2. Good knowledge of dozers and the work they can perform; and the type of terrain they can operate in.
3. Good organizer.
4. Must understand principles of fire behavior.
5. Must have sound judgment.
6. Must be able to make decisions.

### *Dozer Operators*

1. Should be experienced in operating in timber and rough terrain. Experience on dozer operations on logging jobs, land clearing operations or pioneer road work in timbered areas produces good operators.
2. Must be aware of dangers connected with this work.
3. Physically fit, mentally alert. Remember that a dozer is no better than the operator.

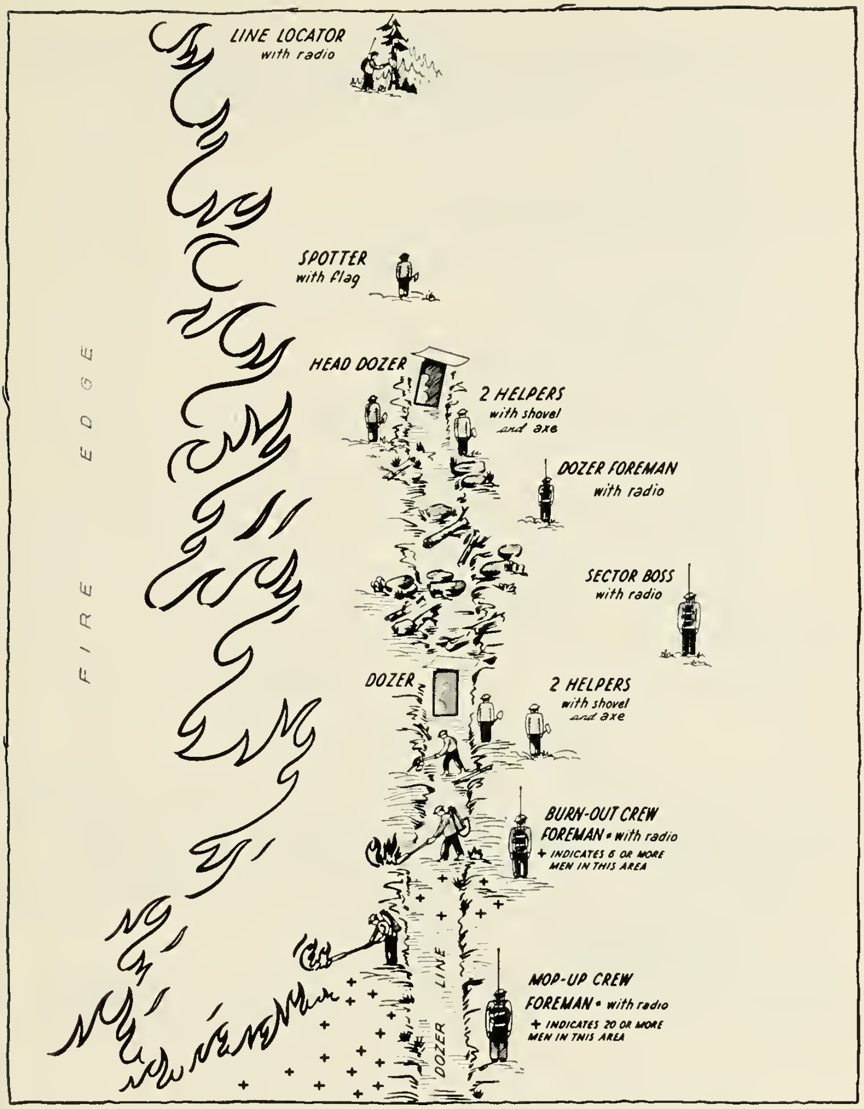

LINE LOCATOR with radio
SPOTTER with flag
HEAD DOZER
2 HELPERS with shovel and axe
DOZER FOREMAN with radio
SECTOR BOSS with radio
DOZER
2 HELPERS with shovel and axe
BURN-OUT CREW FOREMAN • with radio
+ INDICATES 6 OR MORE MEN IN THIS AREA
MOP-UP CREW FOREMAN • with radio
+ INDICATES 20 OR MORE MEN IN THIS AREA
DOZER LINE
FIRE EDGE

FIGURE 2.—Crew arrangement on fire line.

*Spotter*

1. Must understand the principles of line location and line construction.
2. Must know intimately where dozers can work without getting into trouble.
3. Must be physically fit, agile, and mentally alert; and should be able to recognize all the hazards of the job.

Extra operators may fill in on this job; but they should have rest periods between the time that they are operating a dozer and the time they take over the spotting job.

It is essential that the operator have complete confidence in the spotter.

*Mechanic*

1. Should be a tractor specialist.
2. Should be physically fit as it is quite possible that considerable hiking may be involved in a fire assignment.

## EQUIPMENT

1. Dozers large enough to build fire line without saw gang in the lead should be used when available and it is possible to transport them to the fire within allowable time limits. Tractor dozer qualifications are given in table 1.
2. They should be lined up in units (two dozers) where possible.
3. Dozers with the following equipment are preferred as listed by priorities.
    - a. Protector cab.
    - b. Heavy-duty winch.
    - c. Angle blade, quick change.
4. Supplemental equipment recommended with each dozer unit.
    - a. Protector cab, each dozer.
    - b. Heavy-duty winch on at least one dozer.
    - c. Two axes.
    - d. Two shovels.
    - e. Two fire extinguishers.
    - f. One each, 100-foot, ¾-inch cable.
    - g. One each, 20-foot, ⅞-inch choker.
    - h. Two each, single blocks.
    - i. Extra control cable and cable cutter with each dozer.
    - j. Crank for dozers without starters. Keep in secure place so that it cannot be lost.
    - k. First-aid kits.
    - l. Hard hats for dozer crew.
    - m. Wire screen, 3/16-inch mesh, to cover radiator grill to keep debris out, thus avoiding heating.
    - n. Protection for headlights. Items c to m inclusive can be made up into a dozer kit in advance and placed at a strategic point.
5. Fuel and oil. No amounts have been placed on these items as they will vary with availability and estimated length of the job, but don't run short.

    - a. Diesel fuel.
    - b. Gasoline (starting motors).
    - c. Oil
    - d. Grease.
    - e. Grease gun, bucket type.
    - f. Water.

## TECHNIQUES AND PROCEDURES

### TRANSPORTING DOZERS VIA TRUCK OR TRANSPORT

1. If the load is overwidth (as in all the larger dozers), it is desirable to furnish a flagman. This is mandatory in some States. See "Flagman." When available and contacted, the highway patrol will usually act as flagman for emergency trips.
2. When applicable, obtain overwidth permit.
3. Dozers should be chained and blocked against both end and side movement.
4. Transport driver should watch for the following:
    - a. Overhead obstructions.
    - b. Narrow sections of road and narrow bridges.
    - c. Weak bridges—if in doubt unload and bypass where possible.
5. When feasible, include available supplemental equipment and supplies.
6. Place flagmen or flares on the road if it is blocked or partially blocked in loading or unloading operation.

### ROADING DOZERS

1. On roads not suitable for large trucks.
    - a. This will not hurt the tractor if the operator will check the lower rollers and front idlers every 20 to 30 minutes for heating.
    - b. At the first indication of heating (warm to the hand), the rollers should be greased. If permitted to get hot, it will be hard, if not impossible, to hold grease.
    - c. If the tracks are run loose on long trips it will help to avoid heating.
2. Cross country off roads.
    - a. This will be mostly in low and second gear.
    - b. Choosing the best route.
        - (1) Pick a local man (well acquainted with the country) to help in deciding on the exact route to the fire.
        - (2) Make use of aerial photographs.
        - (3) May be desirable to scout possible route by plane or helicopter.

### SECTOR BOSS

1. Coordinate between dozer crew, burn-out crew, line locator, and other crews under his supervision. Be sure the line locator is doing a good job.

TABLE 1.—*Tractor-dozer qualifications*

| Tractor make and size | Weight (approximate) | | | Area track on ground, standard gage | Ground pressure per square inch | |
|---|---|---|---|---|---|---|
| | Tractor | Dozer and control unit | Total | | Tractor only | Gross |
| | *Pounds* | *Pounds* | *Pounds* | *Square inches* | *Pounds* | *Pounds* |
| Allis Chalmers HD-19 | 40,000 | [1]15,675 | 55,675 | 5,118 | 7.8 | 10.9 |
| International TD-24 | 37,500 | [2]12,838 | 50,338 | 4,598 | 8.2 | 11.0 |
| Caterpillar D-8 | 35,950 | 10,365 | 46,315 | 4,389 | 8.2 | 10.5 |
| Cletrac 120 FDLC | 29,760 | 10,410 | 40,170 | 3,840 | 7.8 | 10.5 |
| Caterpillar D-7 | 25,130 | 8,360 | 33,490 | 3,730 | 6.7 | 9.0 |
| International TD-18A | 22,570 | 10,650 | 33,220 | 3,385 | 6.9 | 9.8 |
| Caterpillar D-6 | 16,725 | 5,765 | 22,490 | 2,740 | 6.0 | 8.2 |

| Tractor make and size | Drawbar | Drawbar pull | | Travel speeds | | | | Over-all width standard tread | Ground clearance |
|---|---|---|---|---|---|---|---|---|---|
| | | Low | High | 1st | High | Reverse | | | |
| | | | | | | Low | High | | |
| | *Hp.* | *Pounds* | *Pounds* | *M.p.h.* | *M.p.h.* | *M.p.h.* | *M.p.h.* | *Inches* | *Inches* |
| Allis Chalmers HD-19 | 140 | 50,100 | .. | 0-3.0 | 0-7.0 | .. | 0-5.5 | 109¼ | 16⅛ |
| International TD-24 | 148 | 35,500 | [3]4,650 | 1.6 | [3]7.8 | 1.6 | [3]7.7 | 102 | 13⅞ |
| Caterpillar D-8 | 130 | 28,700 | [4]8,600 | 1.7 | [4]4.8 | [5]1.7 | [6]3.0 | 103¾ | 10½ |
| Cletrac 120 FDLC | 120 | 28,600 | [7]7,150 | 1.6 | [7]5.0 | 1.6 | 2.8 | 100 | 19½ |
| Caterpillar D-7 | 81 | 21,700 | [4]4,270 | 1.4 | [4]6.0 | [5]1.6 | [7]4.1 | 97 | 15½ |
| International TD-18A | 89 | 19,480 | [8]4,780 | 1.7 | [8]5.7 | 1.6 | 3.5 | 82¼ | 14 |
| Caterpillar D-6 | 66 | 17,000 | [4]3,620 | 1.4 | [4]5.8 | [5]2.1 | [7]4.6 | 75¼ | 12½ |

[1] Garwood angle dozer.
[2] Isaacson angle dozer.
[3] 8th gear.
[4] 5th gear.
[5] Low reverse gears.
[6] 3rd gear.
[7] 4th gear.
[8] 6th gear.

2. Keep dozer crew to a minimum for two reasons: a. Safety. b. Men will not work effectively in vicinity of dozers, but are inclined to stand around watching the dozers. Keep other crews out of immediate dozer areas for the same reasons.

3. Instruct burn-out crew to burn out and clean up line behind dozers as soon as possible. This is a must. The size of the burn-out crew will vary depending on fuels and burning conditions but must be adequate to do a good job.

4. Arrange to build by hand those sections of line not suited to dozer construction. Usually this is an early morning job with this crew, switching to line holding and mop-up later in the day.

5. When there is a choice, be sure to order dozers large enough to build the fire line without the necessity of a saw gang in the lead. If a saw gang should be needed, do not overlook power saws. This crew is going to slow down the dozers so anything that will speed them up will step up line construction.

6. Communication. Radio communication, handy-talkies, with the following is necessary for a smooth-running, efficient organization:

a. Sector boss.
b. Line locator.
c. Dozer foreman.
d. Burn-out foreman.
e. Fire boss.
f. Base camp.

7. Line up dozer foreman and line locator on type of fire line to be constructed.

### LINE LOCATOR

This man scouts and blazes line well in advance of the dozers. This is necessary so that desirable line changes can be made before the dozers reach the section in question. The general route marked must be negotiable by dozers.

1. Avoid wet or soft ground.
2. Avoid solid rock.
3. Avoid high-hazard or worse fuels because: a. They slow down line construction. b. Line is harder to hold.
4. Avoid contouring on slopes over 45 percent. Above 45 percent dozers will have to do some excavating to level up, which slows them materially.
5. Dozers cannot climb straight up slopes in excess of 65 percent.
6. Dozers can go down slopes up to 100 percent provided the going is good and the route is clear to the extent that they will not have to back up, as such a maneuver is, of course, impossible.
7. It is desirable that the line locator be equipped with an abney level.

### DOZER FOREMAN

1. Decides on type of fire line to be constructed, based on instructions from the sector boss and on conditions on the fire line.

2. Types of line construction:
   a. Direct.
      (1) Generally use in grass and light fuels where heat from the fire will permit working the fire line.
      (2) Use when possible, where timber values in the area are high and loss from the indirect method would be high.
      (3) Above the fire on slopes over 30 percent if the conditions permit. The reason is that too much time is lost in working fuels uphill against the slope; and where fuels are pushed toward the fire, it is usually better to work in the fire where possible.
      (4) When line will not burn out because of poor burning conditions. This means that the edge of the fire would have to be worked eventually, so the line should be put there in the first place.
      (5) Work inside the fire as much as possible to keep the volume of fuels to a minimum.
   b. Indirect.
      (1) Stay away from the fire far enough so that the dozer will not be in any danger of carrying any fire to the outside of the line when clearing the line and piling fuels on the side away from the fire.
      (2) Allows the line locator and spotter to straighten the line and choose the easiest going. This speeds up line construction.
      (3) This does require a burn-out crew to clean up the line immediately behind the dozers.
   c. Backfire line.
      (1) Used by specialists only in special cases on large, hot fires.
      (2) Wide line is cleared from which to backfire in advance of main fire. A dozer unit can do the work of several hundred men where a wide line is needed to make backfiring safe.
      (3) Advantage is taken of favorable fuels and topography.

    (4) Principles of locating line and setting backfire are the same as for a hand line.
  d. Ditch line below fire on steep ground to catch rolling debris that might fire across a regular line.
  e. General.
    (1) Snagging. All snags that may possibly start spot fires or endanger men working on the line and on mop-up should be pushed down.
    (2) Hot spots or potential hot spots. Dozers should be used to reduce these and scatter the fuels.
    (3) When line conditions permit, in all cases other than direct method of line construction, throw debris away from fire.

3. Must keep the two dozers far enough apart for a safe operation, especially in snag pushing, so that one is always on good, safe ground in a position to help the other in case of trouble.

4. If some manpower is available, it often is good business to skip short sections of line that would materially slow up the dozers provided the dozers can bypass such spots.

5. Be sure tracks are in proper adjustment. They should be fairly tight for sidehill work; this may necessitate adjusting tracks after roading a long distance.

6. Be alert for unsafe work habits—do not tolerate as this is a dangerous operation at best. Be thoroughly familiar with the U. S. Forest Service Safety Code, particularly Sections No. 16, Fire Fighting, No. 39, Tractors, No. 40, Tree Felling, and be sure that the operators are also familiar with these sections.

7. Have plans laid at all times for the safety and escape of crew and tractors in case of a blow-up.

8. Generally instruct lead dozer to break trail and get through in the shortest possible time, not to worry about the kind or amount of work done. Go over top of windfalls, etc., where it is possible to do so safely.
  a. Second dozer is to finish line. This does not mean a road; all that is necessary is width enough to get the dozer through and a line the width of a track pad to mineral soil. If some debris falls back in, it is cheaper and faster to have helpers clear by hand rather than to have the dozer back up for it.
  b. The distance between the dozers will vary, depending on conditions. If held too close together the lead dozer will often hold up the second one. On the other hand, on hot burning fires it is necessary to keep the dozers close together and build a completed line. One of the most important jobs of the dozer foreman is to watch this and make adjustments currently.
  c. Do not separate dozers except on rare occasions such as light fuels and easy slopes. If the dozers are separated instead of worked as a unit, insist on communication with each machine.

9. When working in grand fir or hemlock, caution operators to watch out for sound-looking green trees that are rotten in the center to the extent that they may shear off, causing the tree to fall on the dozer.

10. Inform dozer crew that the operator has a full-time job in looking after himself and his dozer. It is the individual's responsibility to look out for himself and stay in the clear at all times.

11. Arrange for relief operators if the job of line construction will continue for over one shift. Fatigue is a big safety factor on this type of work.

12. Signals must be set up in advance of starting line construction and must be understood by all members of the dozer crew. The following are commonly used. They are given by spotter or foreman.
  a. STOP. Wave flag or light back and forth, waist high with swinging motion.
  b. COME AHEAD. Up and down in front of spotter from the waist to arm's length above head.
  c. TURN. Swing the flag or flashlight on the side to which the operator is to turn.
  d. REVERSE or BACK UP. Full circle in front of the spotter.
  e. CAUTION. Wave flag or light in a half circle at arm's length above head.
  f. CAN'T SEE SPOTTER. Gun motor twice. Given by operator.
  g. WANT DOZER HELPER TO COME TO DOZER. Gun motor once. Given by operator.
  h. ATTRACT OPERATOR'S ATTENTION. One blast on a police whistle or other suitable substitute to attract attention. Given by helper.

13. Equipment and supplies.
  a. Check to see that all necessary items for a successful dozer operation are available or on order. Remember that equipment and supplies can be de-

livered (dropped) by plane on short notice if other means of transportation spells delay.
   b. Keep mechanic readily available in case of a break-down.

### SPOTTER

1. Works under immediate supervision of dozer foreman. Spare operator is often used in this job.
2. Works directly in front of lead dozer, follows the general route blazed by the scout, and signals the operator the exact route. Uses a flag in the daytime and a flashlight at night.
3. Must avoid or warn operator of all hazards that the operator may not be able to see.
4. Make detailed location of the type of line indicated by the dozer foreman, and marked roughly by the line locator.
5. Give the dozer all possible breaks.
   a. Choose the best terrain.
   b. The lightest work.
   c. The shortest route consistent with good fire practice.
6. Spotter must be alert at all times and keep well out of reach of falling timber. Remember, this is the most dangerous job of all; be guided accordingly.

### DOZER OPERATORS

1. Job is to build a completed fire line.
2. When available two dozers usually work as a team.
3. Do not let both dozers get stuck at the same time.
4. Always be on the alert for dangerous snags or trees.
   a. The practice of "rocking" trees to push them over is generally prohibited. Too much danger of the top breaking off.
   b. Always ease into trees and snags. Feel them out before using full power to push them over.
5. You are responsible for an expensive piece of equipment, do not take foolhardy chances.
6. Diesel equipment is safer around fire than gasoline; but don't press your luck. Keep tractor free of excess oil and grease.
7. Be sure your machine is in good working order and proper adjustment. Report any trouble to the foreman at once.
8. When stopping tractor, always place the shift lever in neutral position and engage master clutch.
9. General:
   a. When the fire line has been completed and the fire controlled, it is usually desirable to keep one or more dozers available for a reasonable period as a safety factor.
   b. Dozers can be used advantageously on mop-up, especially in heavy fuels and snag areas, if used wisely. Indiscriminate use will increase the mop-up costs, hence this phase of the operation will require close supervision.
   c. Often dozers will pay big dividends in man-hours by improving the route into a fire and the fire line to the extent that 4 by 4 vehicles can be used in placing mop-up crews on the line. This is a dollar-and-cents matter and the cost of improving the line must be weighed against the anticipated gain.

## OPERATING RULES

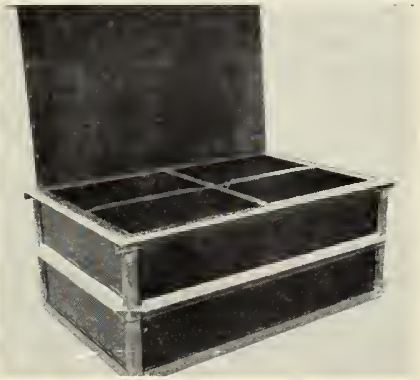
1. Know the Safety Code and live up to it.
2. Calked and hobnailed boots are not to be worn on tractors; composition soles are preferred.
3. No one shall ride on a dozer with the operator, except in the seat and under the following conditions:
   a. On business in safe areas.
   b. Roading in open going.
4. Dozers operating in dangerous, timbered country should be protected from falling tree tops, limbs, etc., by a suitable canopy over the operator.
5. Operators, dozer foreman, spotter, and dozer helpers must wear hard hats when available.
6. The operator shall never leave the dozer seat with the master clutch disengaged except in emergency.
7. No night operation will be permitted in highly dangerous snag areas.
8. Never get on or off a machine while it is in motion.
9. No one should approach a dozer except from a point in full view of the operator and after making sure that the operator has seen him.

# EXPERIMENTAL PLASTIC WATER TANK

### ARCADIA EQUIPMENT DEVELOPMENT CENTER

*California Region, U.S. Forest Service*

In an attempt to construct for fire trucks a water tank that is free from corrosion and long-lived, an experimental tank was designed by a leading manufacturer of rubber and plastic products. It was sent to the Arcadia Equipment Development Center for testing.



The tank, in a steel frame as shown, is fabricated from bakelite. The capacity is 125 gallons.

The tank was tested under conditions which could be expected of any slip-on tanker unit. It was found that after limited testing the tank began to leak around the base seam. Baffle plate also pulled loose. The material in the plates bulged but held up well, the seams alone being deficient.

*Conclusions*: Water tanks designed like the test unit, and fabricated from the same material, are not adequate for the rough treatment to which fire trucks are subjected.

The plates, from which the tank was fabricated, appeared adequate. However, it is doubtful that the material would withstand constant bending for a long period of time.

A more substantial method of cementing and reinforcing joints would be necessary.

It is not advisable to construct fire tanks of material which will burn readily.

Too much support is necessary in the form of framework, which defeats the purpose of lightweight construction.

Tank was fabricated according to plans for steel construction. Possibly construction of a type more adaptable to the material would have produced a stronger unit.

### Still Tying Rolled Hose?

The problem of tying cotton-jacketed, rubber-lined hose in rolls so it can be readily untied was solved for the Cleveland National Forest by Harry Whitney, suppression crew foreman. He cut rubber bands about three-quarters of an inch wide from discarded truck inner-tubes and stretched two of the bands at right angles to each other over the roll. The rolls are securely held in place and can be quickly unrolled by pulling off the bands.—STANLEY STEVENSON, *Fire Control Officer, Cleveland National Forest.*

# PLASTIC BALLS ON RADIO ANTENNA RODS FOR SAFETY

Guy V. Wood, *Communication Engineer,* and Albert H. Schoss, *Communication Technician, Region* 5, *U. S. Forest Service*

The exposed and sharp tips on certain types of antenna rods or whips present a serious physical hazard and can be the cause of severe eye and face injuries.

Certain of the standard mobile antenna rods are supplied with either plastic or metal balls on the tips to reduce the physical hazard. Others such as the Motorola Model P-8253 roof-top mount type are not so supplied, possibly because the rods are originally manufactured and stocked in a single maximum length and are cut (at the tip end) to specified frequency lengths just prior to shipment to the user.

On the Motorola Handie-talkie radiophone Models FHTR-1AL and FH2TR-1AL the short-length whips as supplied have a closed loop formed of the tip end which prevents eye or face injuries. The loop is effective until the whip is caught in the brush or on a limb at which time the loop opens up in the form of a fishhook; it is then a constant hazard to the radio user and to fellow workers.

To overcome the above hazards a plastic (Lucite) ball may be heat-sweated on the ends of these, and other type rods and whips not specifically mentioned, by a simple process as follows:

*Mounting the ½-inch plastic ball to handie-talkie type antenna whip.—*

1. Cut off formed loop on the tip of the whip and file a point so as to provide a tip which will follow a straight course into the plastic.
2. With a knife remove about 1½ inches of the coating on the tip end of the whip.
3. File small notches 1/16, 1/8, and 3/16 inch from the tip end to provide a grip for the plastic ball.
4. Insert the antenna whip in a small vise with the tip extending out about 1½ inches. Heat the protruding tip with a 100-watt electric soldering iron. Do not use an open flame for this heating.
5. By wearing a leather glove it is now possible to slowly force the plastic ball onto the whip while still maintaining contact on the whip with the soldering iron. Avoid touching ball with the iron.
6. Do not make use of a drilled guide hole in the plastic ball, a more secure job results in not using one. It is not difficult to center the ball on the tip.
7. Run the tip of the whip well into the ball but not through it.
8. After cooling, remove the whip from the vise and apply Vinylite or equal plastic cement to the part of whip from which the plastic coating was previously removed. This is to prevent rust and corrosion.

*Mounting the* 5/8-*inch plastic ball to mobile type rods.—*

1. Remove, if present, the plastic plug as originally supplied in rod (i.e., in Motorola type hollow-rod).

2. With a knife remove about 1½ inches of the plastic coating from the tip end of the rod.
3. File notches 1/8 and 3/16 inch from the tip end of the rod to provide a grip for the plastic ball.
4. Grind a point-shaped end on the rod tip to reduce the required installing pressure.
5. Complete the operation by following steps 4 through 8 as outlined for the ½-inch plastic ball.

Severe impact and shear tests run on these finished rods and whips have shown no tendencies on the part of the Lucite balls to shatter or break loose.

As an additional feature, by installing these protective tips on the mobile rods the problem of hooking the rod down during periods of nonuse is greatly simplified.

These particular plastic balls, as used, are stock production items and cost only a few cents each. They are possibly available in most localities from plastic hobby or supply stores.

### Guiding the Fire Chaser

Recently I had an experience which gave me an idea for improvement. One day when atmospheric conditions blended the ridges so one could not distinguish the exact location, I detected a tiny fire two districts away. The other lookout had been taken down so there was no cross reading. I called Fire Control Assistant Nelson Stone of Camptonville, Tahoe National Forest. He got on a ridge known to me and flashed a mirror, and I directed him from there to the fire. The fire was kept an A size even though it was on the district beyond Camptonville.

Now here's the point: 15 minutes later the sun was gone and we could not have received his flash. If we had a *small powerful light* for this purpose, we could prevent lots of trouble in the future. Sounds logical, doesn't it?

The vertical reading couldn't be taken because of old-fashioned windows with cross bars. [In some regions a gasoline lantern has been used for the purpose described.—Ed.]—MRS. MARY GORMLEY, *Lookout, Tahoe National Forest.*

### Tape Guards for Edged Tools

Use two thicknesses of masking tape or adhesive tape folded over the cutting edge of axes, pluaskis, etc. The tape stays on and does not need to be removed to use tools; a few blows cut it free when tools are needed. This safety measure does not interfere with carrying axes in the spring clips on pickups and trucks. The white strip shows up well on the cutting edge of tools at night, an important feature for crews in rough country at night.—CARL O. PETERSON, *Fire Prevention Aid, San Bernardino National Forest.*

# AN EFFICIENT PORTABLE RADIO AIRPLANE ANTENNA

Roy L. Weeman

*Communications Officer, Region 2, U. S. Forest Service*

A review of previous antennas for use with portable radios in airplanes indicates very poor radiation efficiency. In most instances they have consisted of end fed wires of random lengths. Such antennas will not properly

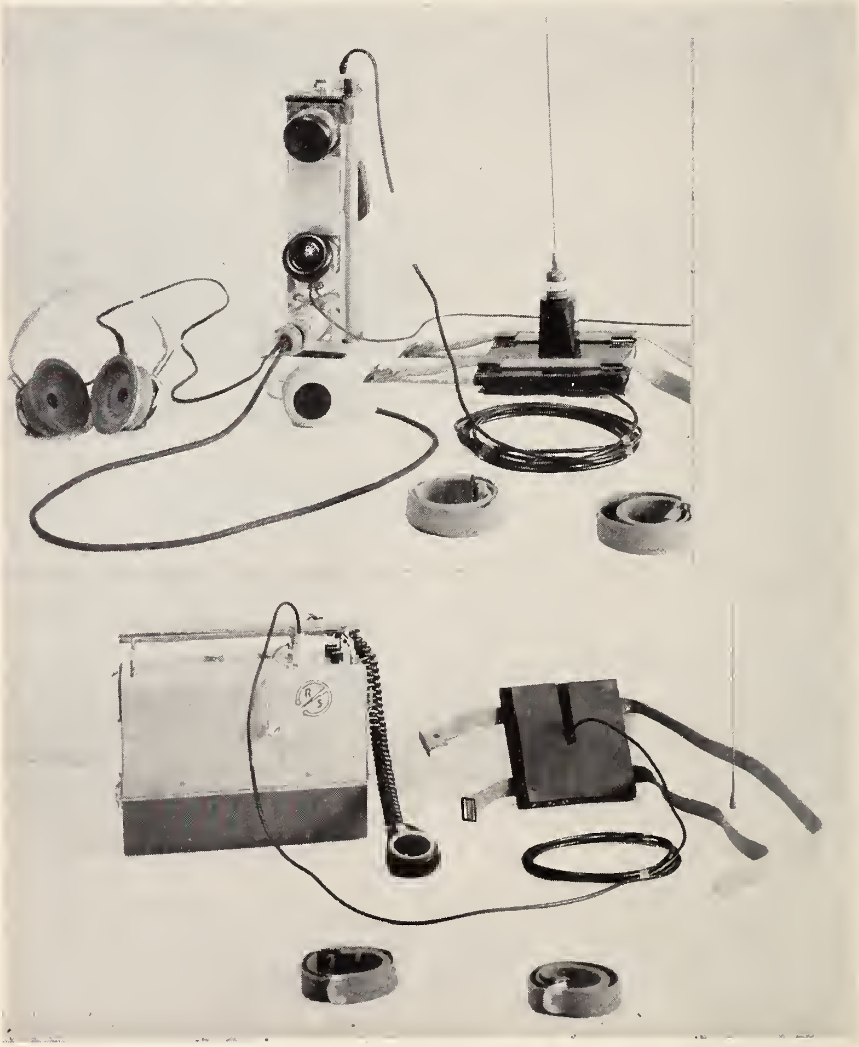


Figure 1.—*Top,* plane antenna with SF model "C" handie-talkie attached; *bottom,* underside of antenna base with pack set attached.

match the transmitter terminating impedance and therefore greatly decrease the energy radiated from the antenna.

This antenna consists of a 43-inch whip properly base loaded to satisfactorily match 50- to 100-ohm coaxial cable. In our installations we have used RG58/U 53-ohm cable, but if a more rugged installation is required, heavier coaxial cable such as RG8/U 53-ohm or RG11/U 75-ohm cable may be used. The antenna whip and loading coil may be purchased for approximately $5 from a leading manufacturer of radio equipment. The loading coil is available for frequencies from 25 to 40 megacycles.

The whip and loading coil are mounted in a hardwood block, 2 by 2 by 4 inches, which is secured to a plywood base, 7 by 7 by ½ inches, with 2-inch wood screws. Web straps are passed through keepers mounted on the top of the base to permit attachment to suitable parts of the airplane (fig. 1). Additional web straps are furnished to secure the lead-in between the antenna, which is located as far from the fuselage as practicable, and the cabin of the plane. The lead-in is attached to the loading coil through a hole in the base and can leave the antenna in a collinear or perpendicular direction. Sponge rubber, ½ inch thick, is cemented to the base to prevent damage to the plane. A slot in the rubber permits the lead-in to leave the antenna at right angles. The lead-in can be any suitable length to serve the various airplanes which may be used. An adapter fitting near the end of the coaxial cable permits the antenna to be used with the pack set, SF model "C" handie-talkie, or the Motorola handie-talkie. The unit assembly may also be readily adapted for emergency mobile use in cars, trucks, and pickups to serve the same radiophones.

When the antenna whip is perpendicularly mounted, excellent results are obtained in excess of 20 miles, with practically a total absence of dead spots. Reports from one region indicate satisfactory operation up to 80 miles when the airplane has sufficient elevation to obtain line-of-sight transmissions.

[Aircraft operators must obtain CAA approval on installation of equipment of the character described in this article. Refer to Part 15, Aircraft Equipment, Air Worthiness, Civil Air Regulations.—Ed.]

# THE POLAROID CAMERA IN FIRE CONTROL

Carlock E. Johnson, *Forester, Sequoia and Kings Canyon National Park,* and Leon R. Thomas, *Assistant Supervisor, Sequoia National Forest*

The recent development of a new type of camera, the Polaroid land camera, manufactured in Cambridge, Mass., has added many possibilities to the use of photography in forest protection. During the 1950 fire season the authors conducted experiments with this camera to determine its value in fire control.

In making the tests one idea was paramount. That was to record vital fire data and to make it available for ground crews in a matter of minutes. These data would include location, relative size of the fire, topography, fuel type, areas of probable spread, wind direction, logical points of attack, and if possible routes of access to the fire. This can be done by means of aerial photos taken with this camera and dropped to ground crews.

The most significant feature of the Polaroid land camera is the fact that a picture can be taken and developed in this camera, on the spot, within a period of 45 seconds to 3 minutes, depending primarily on the temperature of film at the time of development.

The basic camera with exposure meter costs approximately $100. Additional accessories are not necessary. Black and white film costs approximately $1.70 per roll of eight pictures; the pictures are 2¼ by 3¼ inches. The camera loaded with film weighs 4½ pounds. The exposure meter adds another ¼ pound. The over-all size is 9½ by 5 by 2½ inches. Carrying cases for convenience of handling and protection of the equipment are available.

The camera is built for speed and ease of operation. The aperture and speed of the lens are adjusted in one operation and are calibrated in numbers which correspond to the numbers on the polaroid light meter. This makes for simplicity and eliminates the chance of error. The correction for distance is adjusted separately.

After exposure it is necessary to push a button, pull out the film strip, wait the required developing time, then open the back of the camera and take out the finished picture. As with all cameras, a little experience is necessary before one can consistently take good pictures.

Pictures of a going fire are of greater value to the fire boss if they show the conditions at the time of examination. Aerial pictures can be taken with this camera and dropped to the fire camp in a matter of minutes (fig. 1). Combined with observers notes, written in grease pencil on the picture, or by air to ground radio communication, the fire boss or planning officer can quickly and accurately interpret the information.

Heavily timbered and rough terrain often causes delay in locating small fires. In some instances this has resulted in major fires or expenditure of badly needed man-hours. A picture, dropped from a plane, can make this task much easier for the footsore smokechaser.

Lightning storms ofter cause numerous small fires, requiring simultaneous action by the dispatcher. An observer in a plane can easily photograph each

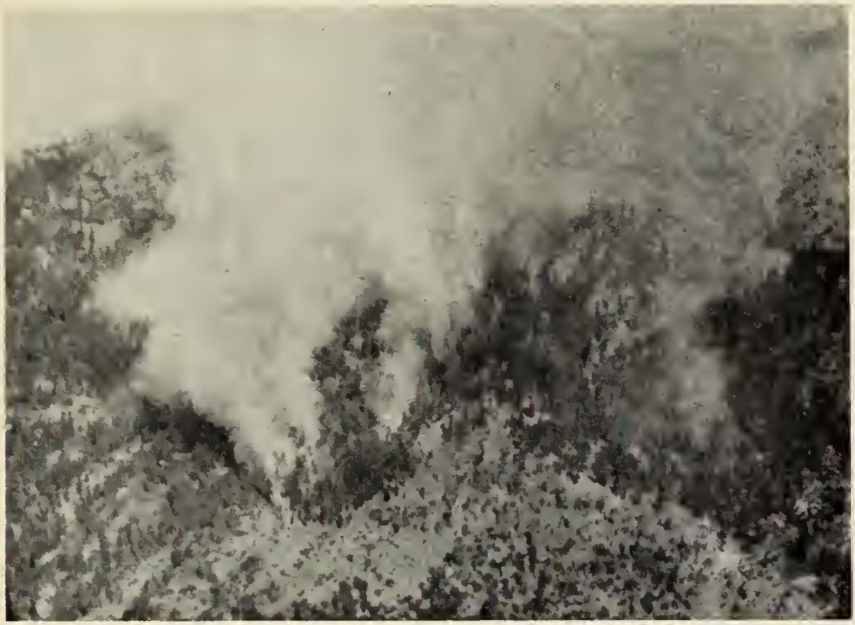


FIGURE 1.—Eagle Peak fire, Sequoia National Forest. Picture taken at 10:54 a.m. about 2,000 feet above the fire. Within 4 minutes after exposure this picture was dropped to the fire boss.

fire at the time of detection or reconnaissance. Decisions as to priority of strength and attack may be largely influenced by the data recorded in the photograph.

Experienced peace officers are well aware of the need to safeguard "Chain of Custody" in handling evidence for submission to courts. This is particularly true in photographing evidence. This camera enables the investigator to act as sole agent in exposing, developing, and submitting photographic evidence. It also ensures the recording of the actual information desired.

There was one serious weakness in the camera used in the experiment—the low shutter speed. A plane is often subjected to turbulent air which, combined with traveling speed, sometimes prevents clear, detailed pictures. Substitution of a faster lens should eliminate this fault.

Areas containing concentrations of smoke do not lend themselves to detail photography. It is believed that this camera will function as well as any other should this arise. However, it probably could not compete with infra-red type film.

Polaroid film does not furnish a negative. Therefore additional prints can be secured only by a number of exposures or by copying the original print. At present only two types of film, "sepia" and "black and white," are supplied by the manufacturer. The "black and white" type is the only one recommended for use in fire work.

The Polaroid camera is not intended to replace the foot scout or the trained aerial observer. It is not foolproof, nor will it meet all needs that may arise. However, it will give on-the-spot factual data and certainly has a place in fire control.

# VOLUNTEER FIRE PREVENTION CLUBS IN OKLAHOMA

WM. MITCHELL

*Assistant Forester, In charge of Fire Control, Division of Forestry, Oklahoma Planning and Resources Board*

Organized volunteers in Oklahoma are handling fire protection with marked success. Since 1948, an unusual record has been made in the development, use, and response of volunteer help in the prevention and suppression of woods and range fires. This has taken place in the upland hardwood type of northeastern Oklahoma, an area of open range with most of the land in relatively small private holdings.

This idea of organized volunteers came from local people. It goes back to a rural mail carrier, Mallay Douglas, who in 1926-28 conceived the idea that community people should do something about stopping woods fires. He preached and talked this idea as he followed his mail route around Sugar Loaf Mountain in Arkansas and Oklahoma.

This idea was slow to take. Finally, one key person became interested in keeping fires off the Mountain. This spread to two and four, and more, until the majority of the community had joined the volunteer forces. Mr. Douglas later got the Bell Telephone Company to contribute enough salvage wire, as a public service, to reach around the Mountain. Volunteers developed with this wire a telephone network for use in warning of fires and in rounding up suppression help.

Communities in northeast Oklahoma became interested in this idea of the Sugar Loaf volunteers. At the start, progress was slow. Two communities in Cherokee County were organized in the fall of 1943, but only after a summer fire had wiped out 14 sections of woods range. The two communities banded 138 members together to protect 54,000 acres of range and woodland. Assistance in organizing was given by the Oklahoma Division of Forestry and County Agent Back of Cherokee County.

Two more groups were organized in 1944. But from 1944 to 1948, progress was poor. By the end of 1948, however, after State personnel had become available to assist in the organizing work, the groups had increased to 22. By March 1950, the number of groups had jumped to 76, containing nearly 1,300 members. Thus, volunteer interest has mushroomed and is now getting ahead of the number of State personnel available for organizing. These volunteers have become a real value in protection work in northeast Oklahoma.

Volunteer protection is a community undertaking. The people band together to form a "prevention club" that is made up of the majority of residents in a community. The Division of Forestry assists in organizing the club, which elects its own fire chief and assistant fire chiefs. All club members sign a Division of Forestry pledge card to prevent fires and to help in fire suppression. Each member is appointed a State Forest Guard and is given an attractive certificate. A supply of State hand tools is assigned to the fire chief. When a fire occurs, the fire chief rounds up the members, gets the tools to the fire location, acts as the fire boss, and makes reports covering the fire.

The volunteer groups give protection beyond the area owned by the members. In the State ranger district at Sallisaw, for example, the 818 members in the 51 prevention clubs own 88,448 acres of land. However, these clubs extend protection to nearly 400,000 acres. The area protected by a club is "blocked in" as much as possible to join the boundaries of any adjacent club.

So far, action on fire suppression by the clubs has been good. In calendar year 1949, 45 fires burned nearly 12,000 acres, or 0.8 percent of the whole 1.5 million acres under volunteer influence in northeastern Oklahoma. Suppression assistance by the State is quite limited. Detection now is done by local people, but a State-operated tower system is being installed. Limited State tractor-plow support is given to the clubs when "back up" is needed.

How the suppression action by the organized volunteers will hold up in the future still is a question. Present indications are that the interest will continue. The State intends to rely on the suppression work by the clubs until it is proved that the volunteers are unequal to the task.

The biggest contribution the clubs make is on the prevention of range and woods fires. Carelessness with fires within a club area has become unpopular. In fact, most of the fires handled by the clubs have come from outside club boundaries. People within a club area who desire to burn over their own land are permitted to do so, provided the fire does not escape to the land of neighbors.

It is possible that fire prevention clubs, as now existing in northeast Oklahoma, can be developed in other States. With this thought in mind, essential points on the organizational work in Oklahoma are listed as follows:

1. Key people to provide leadership in support of volunteer community fire protection must be recruited and "sold" on the prevention of range and woods fires, if they are not already so inclined. The key people "work up" interest of other members of the community until a nucleus has been developed. This group then requests State assistance in organizing a prevention club.

2. The "selling" of community leaders in Oklahoma on the need for preventing range and woods fires has been a job done jointly by many men and many agencies. County agents, Extension Service, Soil Conservation Service, vocational agriculture teachers, Oklahoma A&M College, the Oklahoma Division of Forestry, the State Department of Agriculture, and others have joined hands to put this idea across from many viewpoints. Personal contacts, group meetings, demonstrations, contests, radio and newspaper programs have been the major approaches used. Only through the cooperation of the many agencies has this work been successful.

3. After a community group of 10 or more expresses interest in organizing a prevention club, representatives of the Division of Forestry meet with the local people to discuss the idea thoroughly. The community group then decides whether it wants to form a club or not. When the group decides to organize a club, members are signed up, the area of responsibility and the functions of the club are outlined. In this organizing work State personnel who have ability to meet with and get along with rural people are of utmost value.

4. After a prevention club is formed, State personnel assign a good supply of hand tools and provide a well-designed, weatherproof tool box. Monthly visits to each club also are made to discuss problems with the fire chief, circulate new ideas, prod or stimulate the program wherever necessary, give training in fire prevention and suppression, and show interest in community work and activities. Movies and talks are given frequently. Much "night work" is necessary. These follow-up visits are of great importance in keeping the volunteer groups alert and interested.

In conclusion, organized volunteers in Oklahoma will respond to outside help and interest in community problems. Their effort on prevention and suppression of range and woods fires more than pays for the effort, time, and money involved in the organizing work. Further information on the operation of the Oklahoma prevention clubs can be obtained through State Forester Stauffer at Oklahoma City, Okla.

## Published Material of Interest To Fire Control Men

(*Continued from page 7*)

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*Suggestions for Meeting Increased Slash Hazard in British Columbia,* by D. B. Taylor. British Columbia Lumberman, May 1950.

*Survival of Fire-Damaged Ponderosa Pine; A Progress Report,* by F. R. Herman. U. S. Forest Service, Southwestern Forest and Range Experiment Station Research Note 119, March 1950.

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# "HOT SHOT" CREWS

Stanley Stevenson

*Fire Control Officer, Cleveland National Forest*

Scouting revealed that the head of the Burma Fire of 1949, Cleveland National Forest, was spreading rapidly uphill through medium to heavy brush and would reach the rim of an adjacent watershed unless checked on a small ridge ¼ mile from the top. One "hot shot" crew under Foreman George McLarty, San Bernardino National Forest, had been working the northern flank from the bottom and would reach the top too late to effect the check. The Cleveland "hot shot" crew Foreman, Leon Ballou, and 4 men were flown via helicopter from the southern flank of the fire to the ridge at the head of the fire. The 5 men hurriedly cut a line in front of the fire, backfired it out and started a direct attack on the fire edge down the south flank to meet the rest of the crew. The crew on the northern flank meanwhile had pushed through and tied to the northern end of the fired out line. Although numerous spots occurred and the crews lost the south flank twice because of whirlwinds, they closed the gap and effected control on a 280-acre fire that would probably have more than tripled its size within 4 hours unless the check had been made and the lines tied together.

Since these crews are trained to subsist on the line with bare essentials, a sustained push taking advantage of lulls in fire intensity is possible. This was demonstrated by the San Bernardino "hot shot" crew on the Agua Tibia Fire of 1950.

Lightning started this fire in very steep to precipitious terrain covered with medium to extremely heavy 80-year-old brush and scrub oak. The east flank of the fire had slopped over the planned control ridge approximately ½ mile from the top of the main divide. Helicopter scouting at 10:30 a. m. revealed that if the slop-over could be controlled the lines being constructed from the top and bottom along the flank would probably control that side of the fire.

Foreman McLarty was flown by helicopter around the slop-over and he then jumped about 6 feet to the ground inside the burn above the slop-over. He subsequently cleared a landing spot and 4 additional men were flown in to begin work on the line. Meanwhile, the rest of the crew were started down the ridge top along an old trail. Helicopter coverage guided the crew to their destination where they split forces and started around the slop-over. Although this action was completed within 1½ hours after the initial scouting, the slop-over had spread to a perimeter of approximately 65 chains on a very steep rocky slope in medium to heavy brush oak type.

McLarty and his whole crew worked until dark. They were sent food, lights, and blankets by helicopter. The crew was fed and rested in relays until a "scratch" line was constructed around the slop-over about 11:00 p. m. Early the following morning, the crew was again serviced by helicopter and the fire line finished and mop-up started.

Stubborn aggressiveness on the part of this crew prevented the fire from crossing the drainage and establishing a new head on even more precipitous terrain.

These two examples illustrate the flexibility of "hot shot" crew action. Similar action has been taken many times during the past 4 years. Control possibilities such as these would have been impractical without well organized, trained, and conditioned crews.

One of the "hot shot" crews has been based during the fire season on the Cleveland National Forest. The following notes, although concerned primarily with the Cleveland "hot shot" organization and operational procedures, are representative for "hot shot" crews in the California Region.

The crew is composed of young men whose primary requisites are physical fitness and a will to work. Their lack of experience and conditioning are compensated by intensive training in fire line construction and use of hand tools and fire hose lays at the beginning of each season. These men are termed "fire fighters" and receive fire-fighter rates of pay while on a fire. When not engaged on fire suppression they are paid laborer wages and used on forest projects.

A subforeman or straw boss works with and has charge of from 5 to 8 fire fighters. The straw boss is an integral part of each crew and takes his days off at the same time as the crew. Two assistant foremen acts as crew bosses and are each assigned one-half the straw boss squads. One of the crew bosses is capable of assuming temporary charge of the whole crew during the absence of the foreman.

The crew is under the direct supervision of an experienced fire fighter who can act, as one foreman put it, "from general to father confessor." This foreman must be a skilled leader, fire-wise, and physically fit for very arduous work. He usually assumes the duties of sector boss on fires.

Crew members are hired only after full understanding and acceptance of the rigid rules set up. Camp routine is fashioned after that of athletic training camps with scheduled hours for meals, work, recreation, and sleep. Although some men quickly drop out of the crew because of the difficulty of the job and the rigid dicipline, three have returned each year since 1947 and ten others including the foreman have been on the crew for the past 2 seasons.

Conservation, wildlife, general forestry, and training films give the reasons for the "why" and "how" of forest fire protection. The crew is given instruction in the use and care of fire line hand tools, followed by intensive work-outs on practice fire lines. Several afternoons during the first part of the season are spent on illustrative lectures, orientation, fire behavior, safety, and correct fire line construction practices. Action on early season fires is discussed on the ground with a large part of the constructive comment coming from the crew members.

After several successful attacks on early season fires, crews begin to develop an esprit de corps and an eagerness to prove their ability. Several distinctive arm patches have been designed and worn by crews hailing their identity. The competitive spirit on large fires requiring more than one crew has provided additional incentive toward better production.

The following summary of work accomplishment, although reflecting considerable more suppression time during the heavier fire season of 1950, indicates the advisability of preplanning and budgeting forces primarily for fire suppression.

| | *Percent of total man-hours payrolled* | |
|---|---|---|
| | 1949 | 1950 |
| Cleveland crew activities: | | |
| Training | 12.6 | 6.6 |
| Project work (nonfire) | 10.7 | 17.1 |
| Fire suppression | 48.6 | 62.6 |
| Headquarters camp maintenance and operation, cooks, and annual leave | 28.1 | 13.7 |
| | 100 | 100 |

A sample of fire line construction rates by direct attacks on fire perimeters in Southern California vegetative types, computed from the data recorded on the ground by the Cleveland crew foreman and including rest periods, lunch time, and delays due to lost line, is given in table 1. Comparable line construction rates are difficult to evaluate since the "hot shot" crews are generally placed on lines where untrained or unorganized crews would make very little if any progress.

TABLE 1.—*A sample of fire line construction rates by the "hot shot" crew, Cleveland National Forest*

| Cover type | Condition of crew | Time | Character of fire edge | Slope | Men | Fire line built | |
|---|---|---|---|---|---|---|---|
| | | | | | | Total | Average per man-hour |
| | | | | | *Number* | *Chains* | *Chains* |
| Medium to heavy brush | Fresh | Day and night | Hot | Moderate[1] | 23 | 74 | 0.21 |
| Chamise | do. | Day | do. | Steep | 26 | 135 | .86 |
| Medium brush | do. | Night | do. | do. | 28 | 40 | .35 |
| Heavy brush | do. | do. | Moderate hot | Moderate[2] | 20 | 23 | .23 |
| Chamise | Tired | do. | do. | Steep[3] | 12 | 41 | .34 |
| Chamise and brush | Fresh | Day | Hot[4] | do. | 38 | 23 | .30 |
| Medium to heavy brush | Very tired | Night | do. | do. | 42 | 65 | .25 |

[1] Scattered scrub oak stems.
[2] Very steep ½ mile hike to line.
[3] Some mop-up, rocks, cliffs.
[4] Line abandoned two times because of flare-ups.

The value of a trained unit of men that can be sent into difficult sections of a fire perimeter with a high degree of certainty that control will be effected, has been demonstrated many times during the past. The ever increasing demand for "hot shots" when the going gets rough is the fire manager's endorsement of the "hot shot" program.

# JEEP PLOW

E. E. Aamodt

*Equipment Development, Region 9, U. S. Forest Service*

Recent tests of the jeep and the Newgren-Monroe hydraulically controlled fire plow, conducted in cooperation with the State of Michigan at Roscommon, demonstrated that performance could be improved if the required drawbar pull could be reduced.

Therefore modifications of the plow were made which brought down the drawbar pull requirements more than 50 percent without greatly reducing the width or effectiveness of the fire line (fig. 1). Also, a small change was made in the plow lift lever arms which allows the plow more freedom to follow rough ground and gives the plow about 6 inches higher lift needed for clearance over obstacles and high road centers. The latter is especially important when the jeep is equipped with a tank and carries a full load of water.

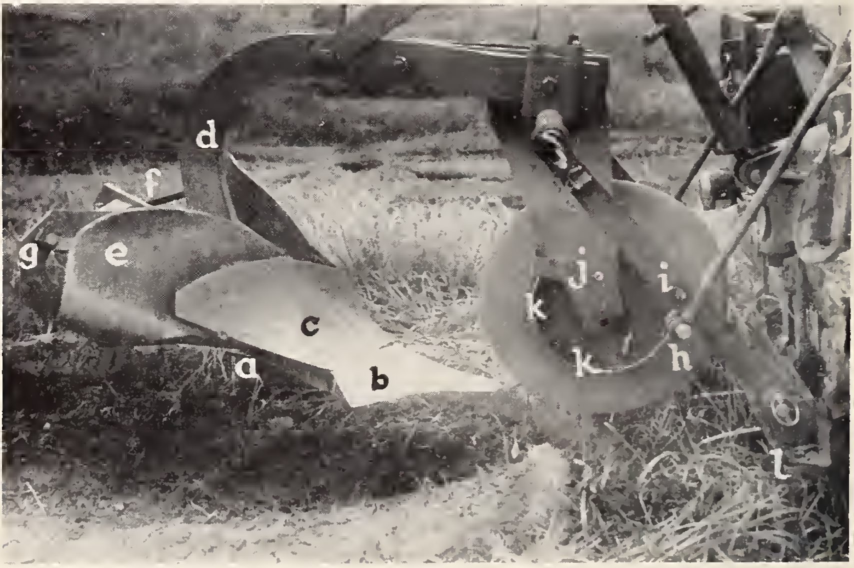


Figure 1.—Details of the modified jeep plow: *a*, Turf knives attached to middlebuster share after disks have been removed; *b*, Newgren middlebuster share; *c*, standard moldboard; *d*, plow beam; *e*, moldboard extension, spot welded to *c*, top loading part curved forward to prevent slip-over and bottom part curved to rear, to push and press down the furrow slice; *f*, extended moldboard brace; *g*, part of commercial plow to which disks were attached; *h*, bracket, with a hole, welded on brace bars to allow higher lift; *i*, old hole and mount for lever arm; *j*, second hole drilled to raise coulter in stony country; *k*, depth control flange, on each side of rolling coulter; *l*, implement drawbar, lowest part of rear of jeep.

The turf knives are the most important part of the modification of the jeep plow. They cut the sides of the furrow slice clear of roots and permit it to be moved up and over into the wheel tracks. A clean furrow without fall-back is the result of the use of properly positioned turf knives (fig. 2).

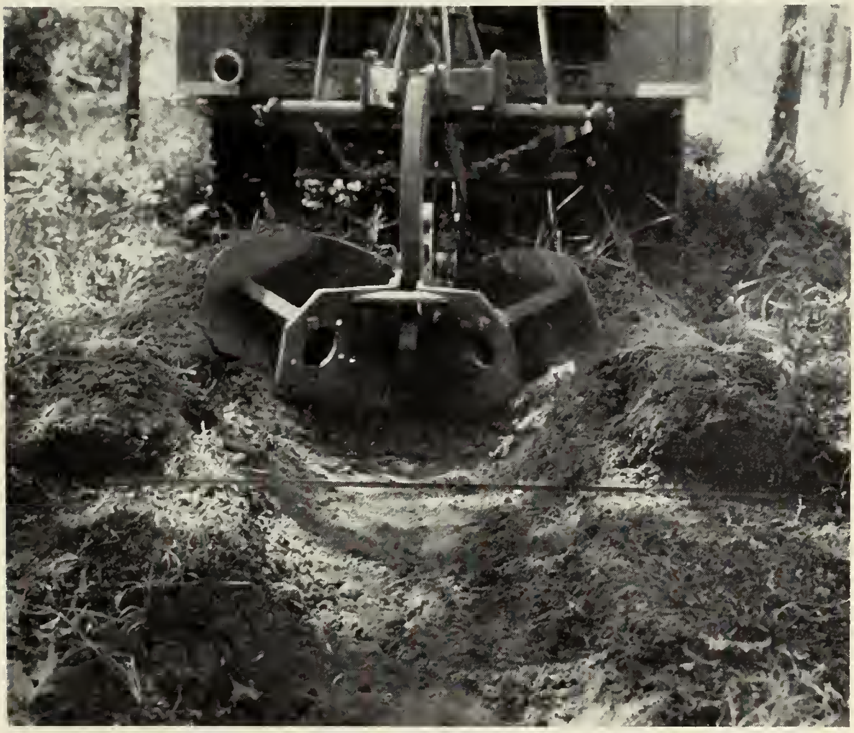


FIGURE 2.—Clean furrow made by the modified jeep plow.

The knives are made up of a single piece of mild steel 1/4 by 4 inches. Welded to the knives are two pieces of angle iron 4 by 4 inches having two holes for bolts that are bolted to holes already drilled into the bottom of the plow beam (fig. 3). The knives are heat-treated and hardened with a compound called "Speedit," and are very abrasive resistant.

The modified plow makes a furrow averaging 19 inches wide, with furrow slice of 13 inches on each side, or an over-all line approximately 45 inches wide. This compares with a 27-inch furrow and 54-inch over-all line width made by the Newgren disk plow when a complete line can be made.

The modifications of the Newgren plow are simple to make and the total cost of materials and labor is about $25. The unit parts could be assembled in kit form and the actual installation made in any shop having an electric welding unit.

Tests made in typical jack pine-oak type gave comparative drawbar pull requirement of 1,238 pounds for the plow without modification and only 382 pounds for the modified plow. The traction and power of the jeep

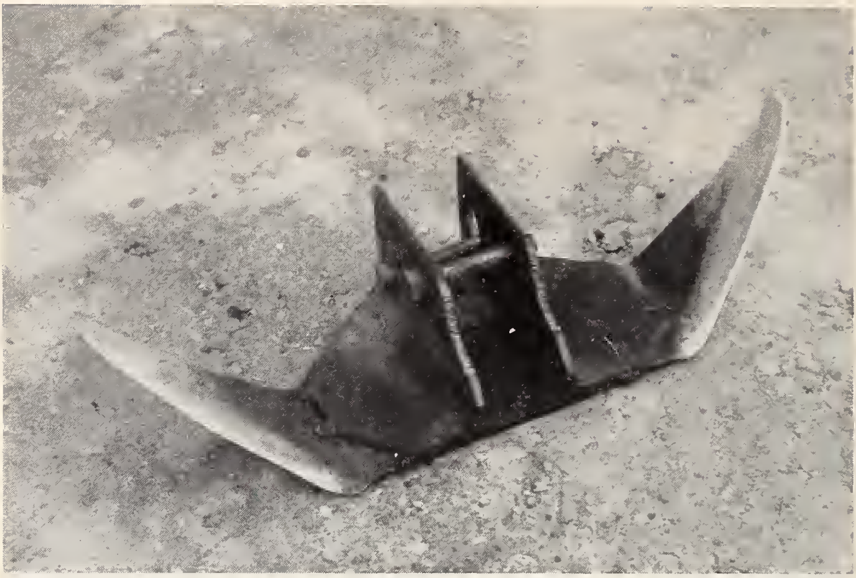


FIGURE 3.—Set of turf knives for modified jeep plow.

were adequate to pull the modified plow in the low, intermediate, and high gear shift range where it was impossible to make a satisfactory line in low gear with the unmodified plow.

The modified plow extends very materially the use of the universal jeep for fire suppression. This plow could be used with any four-wheel-drive vehicle. With increased traction and power, larger moldboards could be used to make wider fire lines.

# MANAGEMENT OF FUNCTIONAL LINE MEN ON FIRES

George S. James

*Assistant Regional Forester, Region 5, U. S. Forest Service*

There must be developed, through thinking and then acting, a fluid type of suppression organization which permits the best qualified attack men to always follow and be on hot fire fronts, has their places on controlled line taken over by men most efficient in holding and mop-up, and develops more supervisory working capacity from the local people for the holding and mop-up phases.

In order to reach these objectives and to become more efficient on each project fire we need to take a fresh look at the procedures used in present-day organizing for suppression. How should our presuppression program be reoriented in order that top management, assisted by plans and service staffs, can direct the suppression forces accordingly.

These thoughts are not new—rather they have been submerged, to a degree, by the rush and complexities involved, particularly on larger fires. Organizational thinking, along these lines, is not pronounced because the biggest job is to select and train men to fill positions in the over-all suppression organization and then to control the fire.

On all large fires there is a tendency to act from thinking in terms of total size and peremeter. More emphasis has been given to total quantities rather than to their component parts. Organizing has been geared to the job of line building without breaking apart the free burning, holding, and cold sections materially and reorganizing accordingly.

As every fire progresses the critical portion of its perimeter becomes less percentage-wise even though the distance around the running front increases. During one or two burning periods this front becomes pretty well stabilized as to length of open line, after which it decreases until control is effected.

We work hard at the job of selecting and training men to fill functional line and plans and service phases for the required organization. Attention is given down to the last details. Now let us consider and point up the two most critical phases of the line suppression task: initial attack, resulting in control; and holding and mop-up, which makes for security.

Selection and training produces men best qualified to fill all of the functional line supervisory positions at different management levels. It should also be used to classify men best suited for initial attack and mop-up, for fires continue to spread because of lack of initiative and aggressiveness in attack and control, and they are also lost as a result of lack of methodical detail in holding, mop-up, and patrol. Thus, the inherent characteristics and capacities of men, along with selection and training, should bracket them to phases of work where their time and energies produce most efficiently.

In all probability we could do a great deal more in developing supervisory working capacity from local cooperators and population if we concentrated on holding and mop-up training and assignments. It is believed, by and large, they could assimilate and become proficient in this phase much quicker than in the more complex job of initial attack.

To create a fluid type of organization, keeping in step with changing management objectives—i. e., from initial attack and control to holding, mop-up, and patrol—means the manipulation, by shifts, of overhead, according to their qualifications to a much greater degree than is presently done. Top management assisted by the plans section can keep attack and control men continually moving to the hot fronts. These men would normally be regular administrative and protection personnel. Their places on controlled line would be taken over by men most qualified to direct holding, mop-up, and patrol. Through an aggressive program of recruitment, training, and regular assignment these positions could well be filled by cooperators and other local people.

It is believed that, using this approach, the recognizing of so many chains of open, holding, and cold line respectively along with the types of men best suited to those kinds of jobs, we will not have to make so many calls for outside help. At least, wholesale requests for overhead would be tempered to quite a degree, depending on the job estimate, i.e., open, holding and cold length of line.

Each forest should examine its own manpower resources inside and outside the Service. Decide what portion of each suppression job should normally be done locally. Think through the needs over and above that. Plan for aggressive and intense attacks on open fronts with attenuating but methodical strength behind. Phases needing emphasis to gain these objectives would be:

a. Select and intensively train forest officers in initial attack and mop-up.
b. Select and intensively train local cooperators in holding and mop-up.
c. Develop both groups through assignments to respective operations on home forests.
d. List qualifications accordingly on dispatch card and memoranda.
e. Forest fire organization.
    1. Break line function down to show—
        (a) Open—initial attack.
        (b) Controlled—mop-up and patrol.
    2. Designate forest officers and cooperators to fill (a) and (b) above.
f. Large fire assignments.
    1. Plans and Records keep inventories of fire line characteristics.
    2. Plans and Records keep list of all men according to qualifications.
    3. Management assign accordingly.

Thus, management of men, by periods and by sectors, can be directed so that a more efficient job is done in fire suppression. It should not add to the complexity of the existing job because when these essential and smaller elements are broken out then thinking and acting will be done accordingly.

# INTENSIVE PRE-PLANNING FOR FIRE SUPPRESSION

HARRY D. GRACE

*Fire Control Officer, Angeles National Forest*

During the development of the fire control portion of the Los Angeles River Upstream Flood Control program it was recognized that we should plan, as a fire control objective, to lower the allowable annual burned area from 0.5 to 0.2 of 1 percent of the total area.

After considering all known factors such as elapsed time, rate of spread, speed of attack, and strength of initial and follow-up forces it was decided to intensify the protection already afforded this highly important watershed. This intensification became one of improving upon the speed of attack plus a pre-planning of fire control lines.

The area covered is that 35-mile stretch of "front country" directly adjacent to San Fernando Valley and the City of Los Angeles. This is an area of 277 square miles, or 177,280 acres, most of which is within the Angeles National Forest. The elevation ranges from 1,200 feet in the valley to 5,800 feet at the summit of Mount Wilson.

The cover type is mainly dense impenetrable brush 2 to 15 feet high. This brush area is in a zone with one of the highest rates of fire occurrence in the Angeles Forest. It is also considered the most valuable watershed in areas in Southern California that have damage appraisal figures ranging up to $1,300 per acre.

With this in mind the purpose of the plan became first, to provide an inventory of all known possible control lines now in existence and such items as water sources, camp sites, helicopter landing sites, and tractor and transport routes of travel and loading areas; second, to catalog all the information on time and materials needed to construct fire control lines and appurtenances on all usable major fire line sites; third, to provide an estimate based upon actual construction work of the manpower and equipment needed to make a successful attack on any large fire occurring within the area.

An attempt has been made to show as much as possible of this data on a multilithed 3-color map, thus eliminating long, written data sheets. In some cases it was necessary to prepare briefly written statements to accompany the map. The detail of this information eliminates the time-consuming scouting job necessary to obtain such data before real fire suppression planning on a large fire can begin. The use of this detailed plan should put the fire suppression job at least 4 hours ahead of a normal planning schedule.

## HOW THE PLAN WAS MADE

The information needed to prepare this fire plan was obtained in the following manner.

Crews of three men were organized to survey each ridge or canyon bottom which might be usable as a fire control line. Each party was made up of a man considered an expert in fire control, a tractor-trailbuilder operator with fire experience, and a key fire guard. Selection of proposed control lines was based upon a knowledge of the country, use of aerial photos, and helicopter reconnaissance flights by the local fire control officer. The survey was started in the winter of 1949-50. Three parties were in the field for a period of 4 months collecting information on 255 miles of proposed fire lines.

Each party was instructed to walk every foot of each proposed line and obtain the information called for in the following outline.

### INSTRUCTIONS FOR PREPARATION OF FIELD NOTES— FIRE PLAN STUDY

1. *Location of fire lane:* Describe location of ridge to be used for fire lane. Tie location into key road, ranch, or some other landmark and note the direction ridge lays. Key numbers, such as A-1 to A-2, will be assigned when data is placed on base map.
2. *If line to be surveyed is an existing break, describe condition:* Describe condition of present cover, that is, grass, light regrowth, etc. If the break is being maintained show the organization doing the work and method used. If this break can be worked entirely by tractor, and is not presently being maintained by another organization, would there be any distinct advantage in yearly maintenance by the Forest Service?
3. *Total length:* Enter the total length of fire lane as determined by actual measurement on the ground. Also enter the length of those parts of the line that will be worked by hand crews and by tractors.
4. *Maximum grade:* Determine the maximum grade encountered on the fire lane. Also enter the maximum grade on parts of the lane that are to be worked by hand crews and by tractors.
5. *Average grade:* Determine average grade by taking not less than four Abney level shots for each mile. The number of readings taken to determine average grade will depend a great deal on the topography being considered.
6. *Minimum width:* Determine the minimum width required for both hand line and tractor line. The following guide lines are for handling construction: Grass, 2 feet; grass with scattered sage, 2 feet; light to medium chamise, 2½ feet; brush mixture with sage, 4 feet; medium brush and oak, 5 feet; heavy manzanita, chamise, or buckbrush, 5 feet; heavy mixed brush, 6 feet.
7. *Time to complete hand line:* Determine man-hours time to construct required hand line.
8. *Time to complete tractor line:* Determine time needed to complete required tractor line. In many cases the time for two tractors to complete required line should be less than half of time for one tractor because of reduced travel time.
9. *Tractor "X" spots:* Describe in detail the bad spots encountered. Give nature of obstruction. Show time required to build around "X" spots. ("X" spots are obstacles that the tractor must work around.)
10. *Transport travel:* Describe in detail the route of travel, from Arcadia, to tractor loading location. Give names of streets, direction of travel, and mileage where possible.
11. *Tractor loading location:* Describe location, size, turn-around area for transports, etc.
12. *Helicopter site:* Describe location of proposed or existing helicopter landing site. Estimate time in man-days or tractor work time needed to brush, level, and improve each site. (These sites are called helispots or heliports.)
13. *Escape ways:* Describe locations of trails, adjoining breaks, and other avenues of escape and safety zones that might be used by fire crews working this fire line.
14. *Water sources:* List all water sources on or near lane being considered. If a tank or reservoir, show number of gallons, ownership, including names of owner in case of private tanks, whose lock, and size and type of thread on outlet. For hydrants show size and type thread. On yearlong ditches and streams show best drafting location. Describe all locations by landmarks, etc.
15. *Fire camp sites:* Describe location of nearest fire camp site, water facilities, telephone facilities, including ownership of nearest phone line. Also make a radio test with Arcadia.
16. *Private land:* If the lane crosses private land try to get the name and address of landowner to assist in obtaining rights-of-way.
17. *Remarks:* Recommendations for preconstruction of any parts of tractor or hand line for this fire lane should be placed here with supporting reasons for recommendation. Also place here anything of additional importance to fire control that

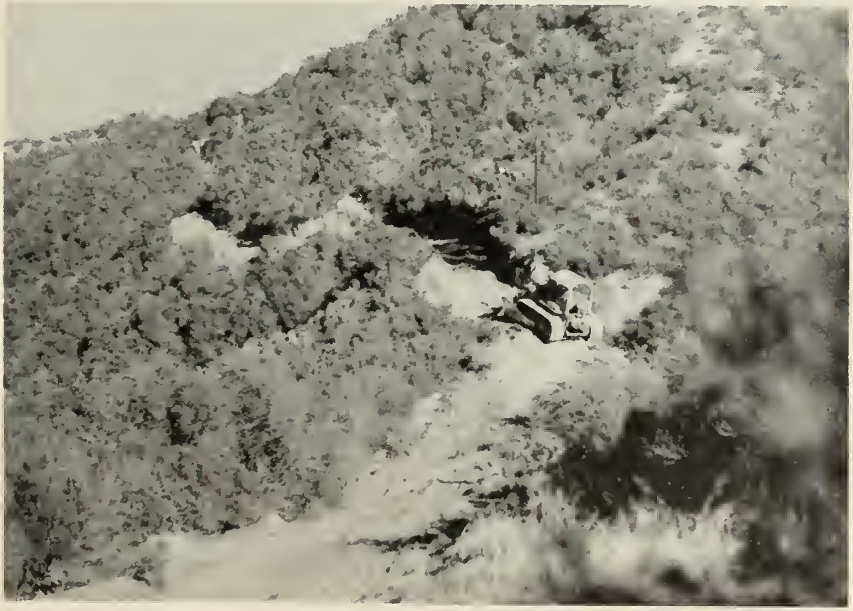
you have observed while making the survey of this ridge. Don't be afraid of putting down too much, for every detail may help the fire boss plan his attack at some future date. BE COMPLETE—BE ACCURATE.

The entire area was broken into seven topographic blocks and each block assigned a letter of the alphabet. As each line within the respective block was surveyed its termini were assigned a number prefixed by the block letter, such as A-1, C-12, etc. Each helispot, water source, "X" spot, escape way, etc., was also designated by identifying numbers. These numbers are shown on the map and were later marked on the ground by a metal sign. This identification system enables the plan user to refer quickly from map to written data and it also assures those persons in the field of a positive ground identification system.

All estimates made of manpower needs, tractor and hand line construction time, and necessary widths of control lines were based upon Region 5 Fire Control Notebook data. In every case estimates were slightly pessimistic.

Field data was recorded on mimeographed field note sheets at the time of survey. The proposed fire line and other information was also noted on U.S.G.S. topographic maps enlarged to a scale of 10 inches to the mile for field use.

From this field data it was found that most of the lines workable with tractors were plagued with "X" spots. These "X" spots consisted of such obstacles as rock outcrops, slopes over 65 percent, soil types that do not afford good tractor footing, and man-made hindrances in the form of high tension power line towers, etc. Wherever such an "X" spot existed it was planned at the time of the survey to build a pioneer road or catway around these spots (fig. 1). This work ranged in time of construction from 30 minutes to 2 days per "X" spot.



F-463454

FIGURE 1.—Tractor-trailbuilder constructing catway around an "X" spot in steep, brush-covered area.

In order to make the plan more workable, it was necessary that these time-consuming construction jobs be eliminated in advance of a possible fire.

Therefore, all such "X" spots were remapped on a work map and a plan prepared for their elimination. One D-7 tractor-trailbuilder was assigned to this work during the summer of 1950. All "X" spots were eliminated except those requiring less than 30 minutes to construct. En route to these "X" spots along ridge tops the tractor built a 9-foot fire lane (fig. 2). These fire lanes are usable fire control lines where the cover is not too tall. In cover more than 2 feet high these lanes provide a ready line for tractors to work from if widening is required. They also provide ways through impenetrable brush fields or into the area for men and tractors, plus tractor-drawn flame throwers and pumpers.

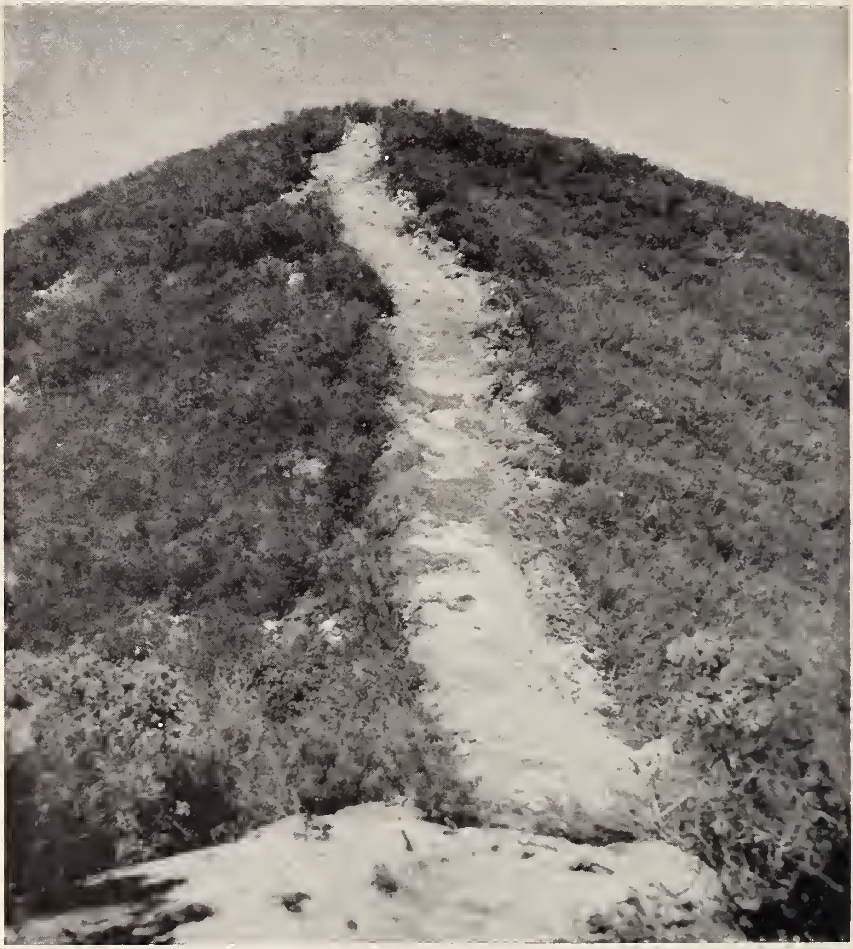


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Figure 2.—Fire lane constructed through heavy brush.

After 10 years these lanes will become overgrown if not maintained. However the information on time of construction and possibilities of tractor use will remain the same indefinitely.

While constructing fire lanes and eliminating "X" spots the tractor also constructed all helispots in the vicinity. This construction program required more than 3 months working time.

After all tractor work was completed a crew of two men posted the identifying signs. These signs were made of metal and consist of a 12-inch equilateral triangle riveted to a 1½-inch iron pipe set in 24 inches of soil cement (fig. 3). The triangle is painted orange and the post black and orange. These colors were found to be the most visible in brush areas. These markers or signs eliminate the possibility of fire crews taking the wrong ridge on a proposed line, and they make night identification of ridges positive for line construction crews. Air reconnaissance men can also see the markers from the helicopters.

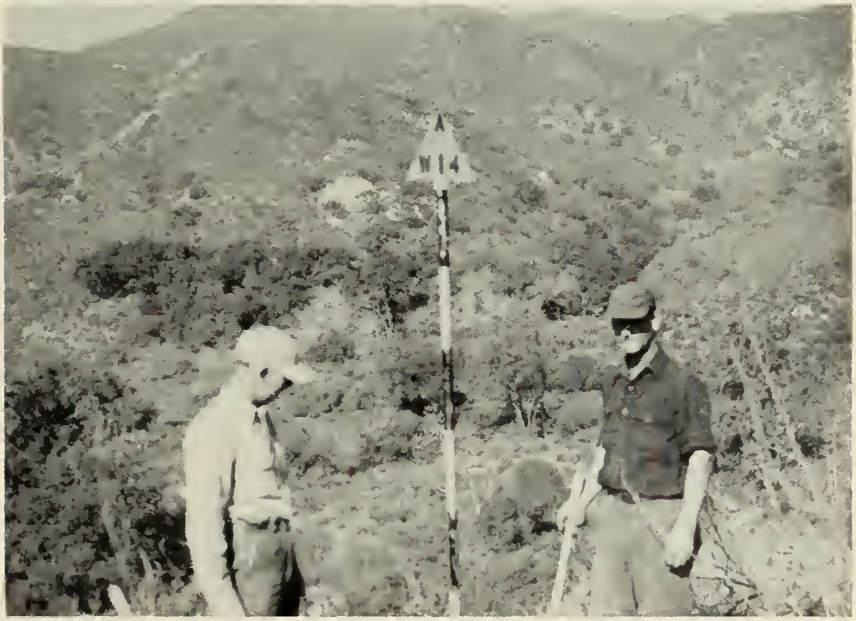

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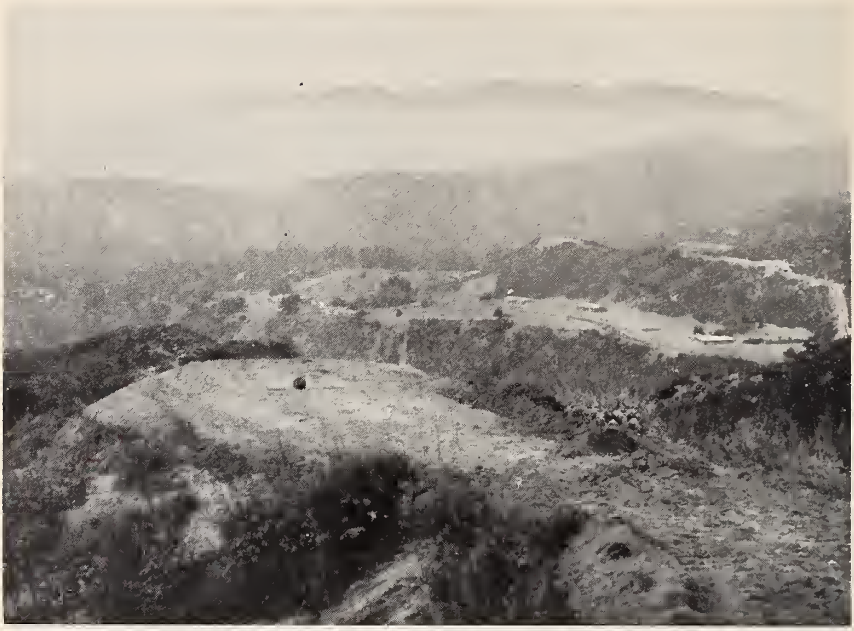
FIGURE 3.—Type of marker to identify key points in plan.

The sign crew also constructed helispots on those ridges where tractor work was impossible. Hand-constructed helispots range in size from 15 feet in diameter (brush clearing) to 25 feet. This size helispot will easily accommodate a Bell or Hiller helicopter. Where a tractor was used to construct a helispot the size averages 60 by 60 feet (fig. 4). These larger helispots will accommodate a Sikorsky or Piasecki helicopter, which it is hoped will be available in the near future for transporting 8 to 10 men at a time to the fire line. These larger helispots can also be used as safety zones for crews during possible blow-up fire conditions.



F-463457

Figure 4.—Helispot constructed by tractor.

After the field survey was completed it was checked by the local fire control men for possible omissions or errors in judgment.

The field notes were then condensed and as much information as possible was transferred to the field map which was then reduced to a scale of 2½ inches to the mile and multilithed (fig. 5). The multilithed map was then broken down into sheets 8 by 10½ inches and placed with the descriptive data in a loose-leaf binder.

## USING THE PLAN

When a fire occurs in the area covered by this plan the following action is taken:

1. Prompt initial attack by men and tankers using direct methods is made while the fire is small.

2. If initial attack forces fail to control the fire while it is small (possible failure of a direct attack is usually determined within 30 minutes after fire is first hit), the fire boss then utilizes the intensive pre-plan data in his copy of the fire plan. On the basis of this data he lays his plan of attack. This information eliminates the need of extensive air and ground scouting *before* over-all plans can be made. In other words, the fire boss has at hand the information needed to make a comprehensive attack plan *now*, not 3 or 4 hours after the fire is known to be a potential large fire, as is the case when ground and air scouting is required.

3. The fire dispatcher, when notified of a fire within the fire plan area, refers to his copy for information on fire needs. If the area is workable by tractor, a tractor transport is dispatched at once to the nearest

tractor unloading spot via a predetermined route of travel. Helicopters are also dispatched to nearest heliports, etc.

Annual revision and maintenance of this plan will be required because of the intensive use of the area. New roads, power lines, and residences will add to or eliminate certain parts of the plan. Each year changes in the plan will be noted by the district ranger and his field men. This information will be turned over to the forest supervisor who will assign personnel to the winter job of keeping the plan up to date.

## USE OF PRE-PLANNING ON A SIMULATED FIRE

A fire starting in Schoolhouse Canyon near point A-23 (fig. 5, bottom center) has spread beyond possible control by the initial attack forces. Weather conditions are average bad and the rate of spread upslope in a northwesterly direction is 60 chains per hour. The time is 3:30 p. m. and a wind change from southeast to northeast at 10:00 p. m. is predicted. Rate of spread will decrease to approximately 10 chains per hour after a rise in humidity which was forecast for 6:00 p. m. With this information and the pre-planning data the fire boss is now ready to prepare a comprehensive fire suppression plan for the Schoolhouse Canyon Fire.

He first predicts the rate of spread by 2-hour burning periods. According to his calculations the fire will reach helispot AH-14 on the ridge in about 2½ hours.

Referring to his map (fig. 5) he decides to make a stand on ridges A-17 to A-16; A-16 to A-20; and A-20 to A-26. These ridges were picked as they are the nearest preconstructed fire lanes and he stands a chance to backfire from them.

A fire camp is selected at AFC-6, and the tractor transports are ordered into AT-6 and AT-4, which is not shown on map but is 1 mile west of point AW-5.

A helicopter, which is an initial attack tool on this forest, arrived along with the first crews some 30 minutes before this plan was made.

Using the helicopter to transport some of the initial attack men to helispot AH-16, which is the highest point on the ridge, the fire boss prepares to backfire. Other helicopters are ordered to transport more fire fighters to the fire line.

Initial-attack, 4-wheel drive, 300-gallon tank trucks are dispatched up road to points A-20 and A-25 to aid in holding line to be backfired.

Referring to the fire line data the fire boss determines the following:

A-16 to A-17: Orders 2 tractors to widen fire lane to 40 feet and 40 men to build hand line and hold backfire. (See sample Fire Line Data.)

A-16 to A-20: Orders 2 tractors to widen old firebreak and 60 men to hold backfire.

A-20 to A-26: Orders 2 tractors to complete widening job from A-20 to A-25. Orders 60 men to handle backfire along this line. (A-25 to A-26 is firebreak 40 feet wide and no further work is needed.) Men on upper part of fire line are to be fed and supplied by fire camp located at AFC-5.

Tractors to be provided with fuel and fresh operators by helicopters using those helispots along the line. Some hand crew men are spotted along the line by helicopter to save long walking distances and time.

Fearing a possible blow-up during the next day if northeast winds should continue, the fire boss redistributed his tractors after all lines are widened. Two tractors are sent to A-28 to widen line from that point to A-29 as a safety line.

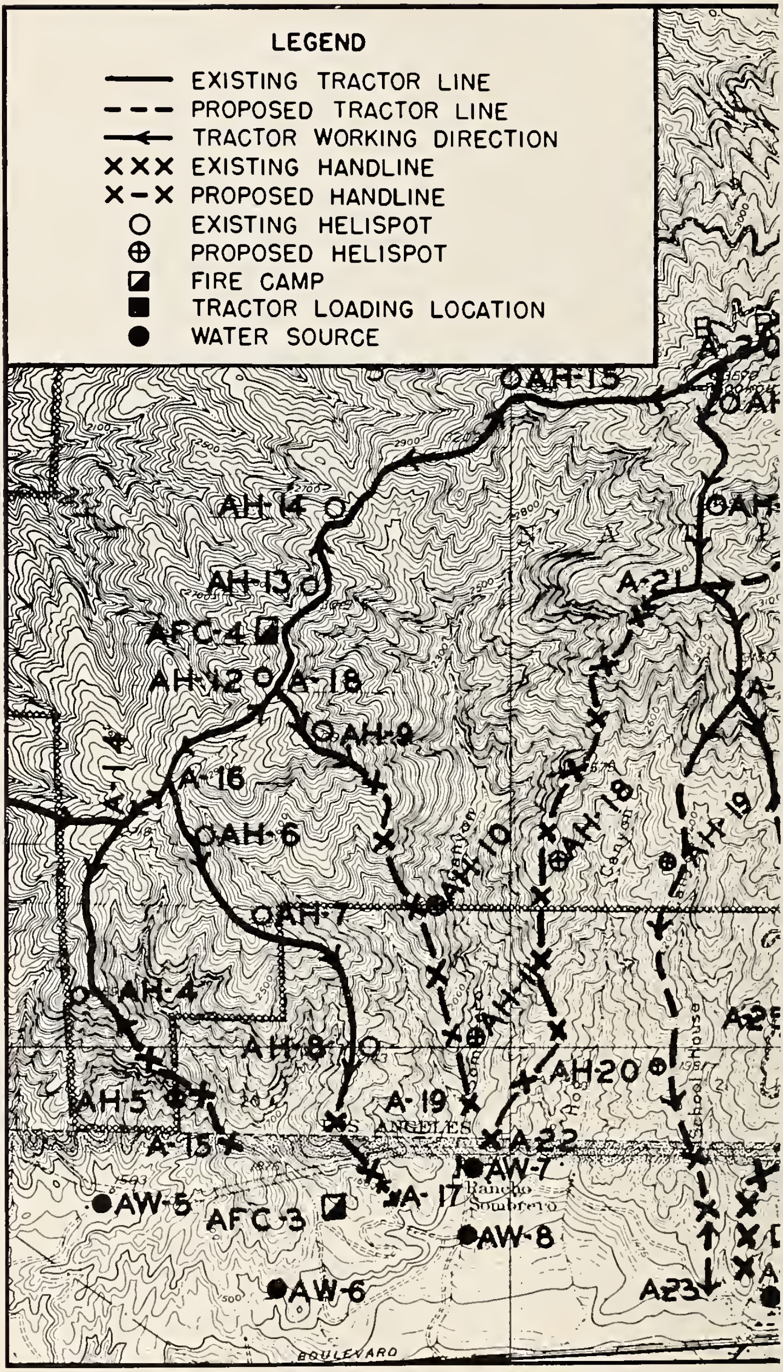


Figure 5.—Part of area covered by intensive plan; scale: 2¼ inches equal 1 mile.

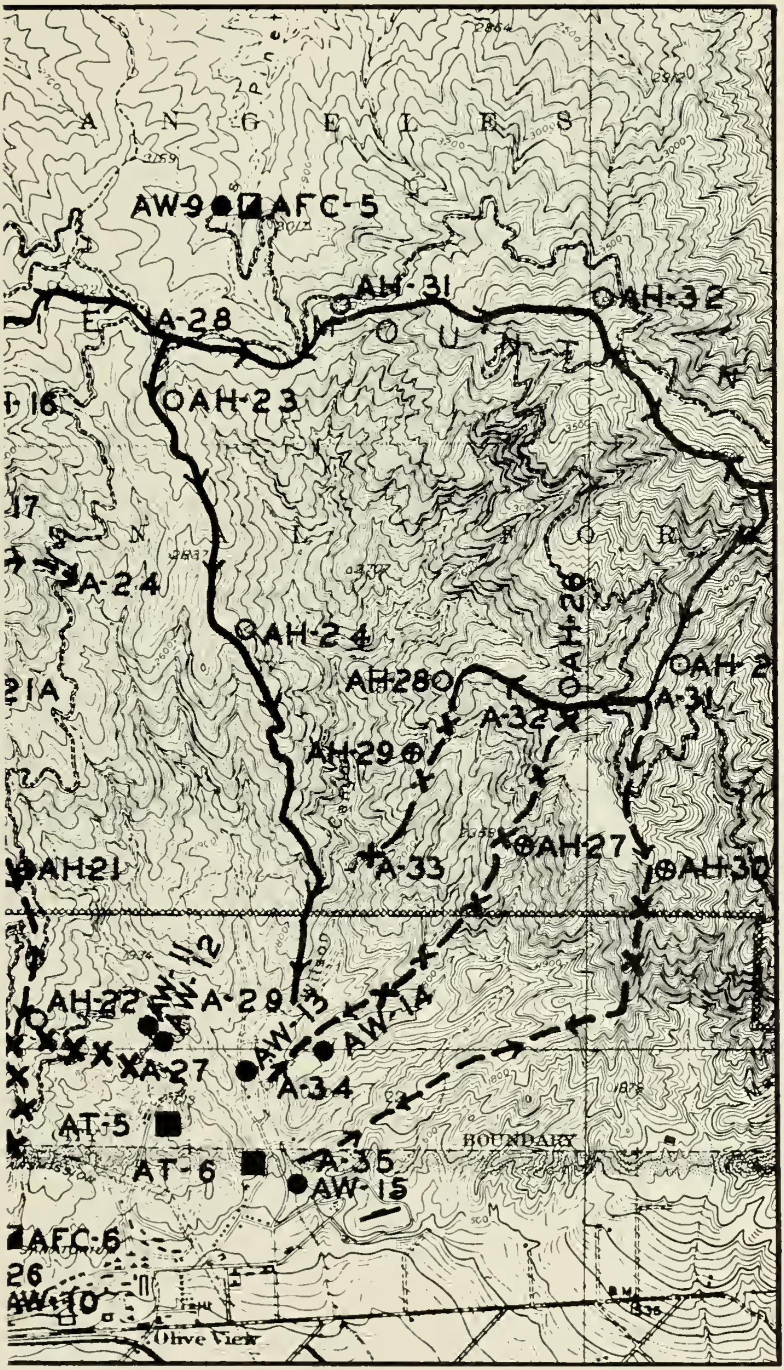


Figure 5 continued.

## SAMPLE DATA

The following are examples of the line, fire camp, and transportation data that accompany the maps.

### FIRE LINE DATA

East ½ of Block A

A-14 to A-15 *HAND LINE:* 33 ch., 96%, med. brush, steep knife ridge, 15-ft. line required, 160 man-hrs. *TRACTOR LINE:* 33 ch., 37%, heavy brush, 40-ft. line required, 1 cat 6 hrs., 2 cats 3 hrs. *TRAVEL:* Tractor from AT-4 via Grapevine T.T., A-13, A-12 to A-14, 1¼ hrs. *HELISPOTS:* AH-4, ¼ hr. tractor, 4 man-hrs.; AH-5, 2 man-hrs. *WATER:* AW-4, 3,000 gal. Circle M Ranch draft; AW-5, 5,000 gal. Symonds Reservoir draft. *FIRE CAMP:* AFC-3.

### FIRE CAMP DATA

East ½ of Block A—AFC-2 to AFC-6

AFC-6 Located at Olive View Park. From Foothill Blvd. at east end of Olive View Sanatorium, turn north on Colbalt Ave. to Olive View Ave. Turn right (east) on Olive View Ave. to Sycamore Ave. Turn left (north) on Sycamore Ave. to AFC-6 at Olive View Park. Water from Olive View water system available at campsite. Telephone available at Olive View on Calif. Water & Tel. Line. Radio communications with A-50 at Newhall R. S.

### TRACTOR LOADING AND ROUTE OF TRAVEL

Block A

AT-6 Transport tractor via Foothill Blvd. to east end of Olive Sanatorium. Turn right (north) on Colbalt Ave. to Olive View Ave. Turn right (east) on Olive View Ave. to Sycamore Ave. Turn left (north) on Sycamore Ave. to AT-6 at Olive View Park near gate on the Armstrong Ranch. 1½ hours transport travel from Arcadia.

## CONCLUSION

This type of intensive fire suppression plan is not a luxury for an area in which flash fuels and high values make fast, well-planned action imperative. Minuteness of detail eliminates the time-consuming scout work which is needed on a going fire to prepare a successful fire suppression plan of action. Because this data was collected by experienced fire men not under the pressure of fire conditions it also eliminates the possibility of unusable information reaching the fire boss.

## INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed in the manuscript immediately following the paragraph in which the illustration is first mentioned, the legend being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

When Forest Service photographs are submitted, the negative number should be indicated with the legend to aid in later identification of the illustrations. When pictures do not carry Forest Service numbers, the source of the picture should be given, so that the negative may be located if it is desired.

India ink line drawings will reproduce properly, but no prints (black-line prints or blueprints) will give clear reproduction. Please therefore submit well-drawn tracings instead of prints.

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# FIRE CONTROL NOTES

A PERIODICAL DEVOTED
TO THE TECHNIQUE OF
FOREST FIRE CONTROL

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FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 12 Number 3

# FIRE CONTROL NOTES

## A Quarterly Periodical Devoted to the TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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# THE POSSIBLE RELATION OF AIR TURBULENCE TO ERRATIC FIRE BEHAVIOR IN THE SOUTHEAST

GEORGE M. BYRAM AND RALPH M. NELSON
*Division of Fire Research, Southeastern Forest Experiment Station*

["Blowups" and other forms of unaccountable fire behavior, that characterize many of our more disastrous fires every year, were a special topic that was given much emphasis at the fire meeting held in Ogden in January 1950. New research on this problem was urged and all research men were urged too to make available every bit of new information that might be useful to the fire strategist even though this might mean some reporting ahead of final evaluation. I am very happy to present the following report by two members of the research group as new information that I personally believe is highly significant though further confirmation, evaluation, and means of prediction are needed and will require much further investigation. If the degree of local stability in the atmosphere proves to be a key factor in the unexpected and often dangerous behavior of many of our large fires, and it can be identified in advance, one more of the unknowns will be eliminated and skill in control of large fires can be greatly advanced. This preliminary report should be a challenge to all experienced fire fighters and research men alike. Have we been ignoring one of the controlling factors in big fire behavior?—A. A. Brown.]

Fire control men have long suspected that there are unidentified factors that contribute to the strange behavior and spread of some fires. H. T. Gisborne, G. L. Hayes, and A. A. Brown, among others, have believed that atmospheric instability might in part explain some of the western blow-up fires. Brown (1) and Crosby (2) speaking more generally have stated that when sufficient heat is generated by a fire in an unstable atmosphere, erratic fire behavior can be expected. In a report from Australia (3), turbulence is stated to be an important factor in the degree of severity of bush fires and that it is of value in compiling forecasts of fire weather. There is now reason to believe that turbulence may also be associated with certain severe fires in the South. Some evidence on this point was obtained from fires that burned in an unusual manner in the Coastal Plain of South Carolina during a few days of the 1950 spring fire season.

Southeastern States experienced an unusually severe season during that period. A prolonged drought, interrupted only by occasional rains, began in November and persisted in some areas until May. This brought about abnormally low fuel moistures which, combined with high winds, resulted in a large number of fires and a large acreage burned. Apparently there were two rather definite types of severe fires. The first, driven by high winds, was characterized by high rates of spread, especially while crowning. From the standpoint of the safety of suppression crews and their equipment, this type of fire has not been considered dangerous for experienced firefighters in the Southeast. The second type differed from the first in that its peculiar whirling nature and unpredictable behavior made even a flank attack dangerous. It is with the second type that this report is concerned.

## THE BUCKLE ISLAND AND FAREWELL FIRES[1]

Following is a description of two whirling fires that occurred on the Francis Marion National Forest in South Carolina. So far as can be ascertained, they had characteristics of behavior common to fires that burned elsewhere in the Coastal Plain of that State during the five or six most severe days of the spring season.

The Buckle Island No. 144 fire burned on March 26 in a densely stocked stand of loblolly pine 10 to 35 feet in height. The day was sunny with little wind during the morning hours. The relative humidity was medium (about 35 percent) and the records of the Weather Bureau airport station, located approximately 40 miles from the burned area, indicated a layer of highly unstable air about 400 or 500 feet deep at 10 a. m. The layer probably had become even more unstable and somewhat deeper at the time the fire started in the early afternoon. However, the increased turbulence may have been partly offset by an increase in wind velocity which took place at about noon. Apparently no large whirl developed until the fire reached a size of 40 or more acres. One then enclosed the head and created trouble for the plow crews. Because the early spread of the fire was nearly at right angles to the road, no short cut to the head was possible. Therefore, a flanking attack on both sides was made. As the plow crews progressed, the fire on the left flank had a tendency to cross in front of the crew, and on the right flank, behind the crew. One large counterclockwise whirl or two such whirls, one on each flank, could account for this strange behavior. It was later found that there was at least one small whirl on the right flank, although from the plane observer Mitchum saw only one large whirl.

The Buckle Island fire differed somewhat from other whirling fires in that it apparently maintained a fairly constant direction of spread. The wind velocity was also greater and steadier than on other fires. Even so, the spread was erratic. At times the fire would quiet down and then suddenly burn with fierce intensity. These bursts may have been caused by the almost simultaneous ignition of several acres by the whirl. In one instance, the plow crew observed flames directly overhead while the main fire was still some distance away.

The most severe fire on the Francis Marion National Forest during the spring season from the standpoint of erratic behavior and its whirling nature was Farewell No. 172. It burned on April 11 with a light but variable southwest wind in a stand of loblolly reproduction 10 to 35 feet in height which contained a scattering of mature trees. Weather Bureau records indicated a high degree of atmospheric instability also on that day. There were three large whirls in this fire and at least two small ones. The paths of the larger whirls were approximately parallel and were separated by less severely burned strips 75 to 100 feet in width. Needles on tree crowns in the strips were not consumed, and in a number of places the tops of crowns of trees 25 feet high remained alive. However, in the paths of the whirls the crown foliage was generally completely consumed, on some trees to a height of 80 feet. Needles are not completely consumed unless they are well within the flames, so it is estimated that the flames may have ranged from 50 to 150 feet in height.

---

[1] Acknowledgment is made to John T. Koen, formerly ranger on the Francis Marion National Forest, to John T. Hills, Jr., and Aiken Mitchum of the National Forest staff for eyewitness accounts of the fires reported upon.

After becoming established, the whirls moved rapidly ahead of the main fire with sufficient updraft to carry burning embers aloft. These embers are reported to have started fires a considerable distance ahead of the main fire. Airplane observer Mitchum believes that two of the three whirls burned at the same time. He also observed that flames came out of the center of the tops of the cone-shaped whirls. The flames did not spring directly upward but had the same rotary motion, spiralling upward, as the smoke in the outer parts of the whirls.

## SOME CHARACTERISTICS OF ERRATIC FIRES

Evidence from the Buckle Island and Farewell fires, and from others that burned in South Carolina during the spring season of 1950, indicates that erratic fires in the Southeast may have some common characteristics. Also, there appear to be certain conditions of weather, fuel, and type—not fully identified—which are conducive to such fires. Although some of the following conclusions regarding fire behavior and possible causes are speculative, they appear reasonable in view of what is known of certain physical laws. Confirmation or disproval will require further observation and analysis.

1. Fires with erratic behavior are most likely to occur on sunny days when there is strong surface heating. There may be little or no wind during the early part of the day, and even while the fire is burning, usually in the afternoon, the general wind is light or moderate. The most favorable wind for this type may be somewhere between 8 and 16 miles per hour as measured 20 feet above tree tops.
2. Erratic fires have a tendency to develop one or more violent whirls after reaching a certain critical size. The size is probably not the same for all fires and may be somewhere between 20 and 75 acres. This, however, is merely conjecture.
3. From the air, the diameter of larger whirls appeared to remain approximately constant and to cover an area of about 10 acres. An increase in size after they had formed was not observed. Possibly they appear suddenly and may be nearly full-size when born. After becoming established, the whirls apparently can move rapidly away from the main fire and take the direction of the light wind prevailing at the time. They can consume strips of reproduction 500 to 800 feet wide. The velocity with which these whirls travel is one of their most dangerous characteristics because their speed may be equal to, or nearly equal to, the velocity of prevailing winds.
4. Field men state that most of the worst fires occur on days with a southwest wind. This indicates a characteristic pressure system which may also account for some of the turbulence. Observers in airplanes have noticed that the air was always bumpy on days when whirling fires occurred. Also, when the flying became smooth in the late afternoon whirls did not occur.
5. It cannot be assumed that whirls will always rotate counterclockwise like large-scale vortex storms such as hurricanes in the northern hemisphere. The counterclockwise rotation of the hurricane is caused by the rotation of the earth. This should have but little effect on small-scale whirls like dust devils or whirling fires. For this reason the chances are probably about equal that the whirls will be in either direction.
6. The depth of the turbulent layer may be a dominating factor in de-

termining the maximum size of the whirls, although other variables such as quantity of fuel should also have some effect.

7. In flat country it is doubtful that large whirls could develop if the air were absolutely calm, regardless of turbulence. Some wind movement would be necessary to move them over fresh fuel. A high wind, on the other hand, would reduce turbulence and might also tend to break up the whirls. This does not mean that fires burning in a high wind will be less intense than fires burning in a light wind. A large majority of severe fires probably burn on days of high wind velocity, and rate of spread will increase with increasing wind velocity.

8. The effects of turbulence in areas of rough or rolling topography would be considerably more complex than in flat country. Turbulence near the ground surface would probably never be as great as in flat country but this would possibly be more than offset by complex topographic effects. For example, large whirls could travel upslope rapidly even in an absolute calm.

9. An important factor in the occurrence of the whirling type of fire may be the fairly recent change in stand type in much of the Southeast. During the past 15 years extensive stands of dense pine reproduction have become established on areas formerly kept clear of pine by repeated fires. This may be one reason why there have not been more of these fires in former years. On the other hand, they may have occurred more often than is supposed. It is difficult for ground crews to recognize large whirls because of smoke and a limited field of view. They can be seen best from the air.

10. Perhaps too much emphasis should not be placed on just the whirling characteristics of fires burning in turbulent air. Turbulence could have a pronounced effect on the draft of a fire long before it reaches the whirling stage. It was noticed that on days when there was high turbulence, even small fires burned with strong drafts. The opposite of this has long been familiar to fire fighters. Fires usually undergo a pronounced change in behavior in late afternoon and evening when the atmosphere becomes more stable. This change has often been attributed to the increase in relative humidity which accompanies the drop in temperature of the lower air layers. It is possible that an increase in air stability may have as great, or greater influence on behavior than a combination of increased fuel moisture and decreased fuel temperature.

## THE INFLUENCE OF ATMOSPHERIC INSTABILITY ON FIRES

Unusual fire behavior, not previously experienced, was reported for the Francis Marion National Forest on March 26, April 11, 17, and 24, by suppression crews. This behavior, characterized by one or more whirlwinds and by sudden fierce upward bursts of flames, could not be accounted for by any exceptional conditions of fuel or wind. This led the writers to suspect that some unusual atmospheric conditions existed at the time of the fires. Accordingly, 10 a. m. lapse-rate records for the 4 days mentioned were obtained from the Weather Bureau station at the Charleston airport. These are graphed in figure 1.

The straight dashed lines in the graph represent the dry adiabatic lapse rates, that is, a decrease in air temperature of 0.53° F. per hundred feet in height. At this rate of decrease the atmosphere is neutrally stable. The greater the drop in temperature with height, the greater the air instability. Conversely, the less the drop in temperature with height, the

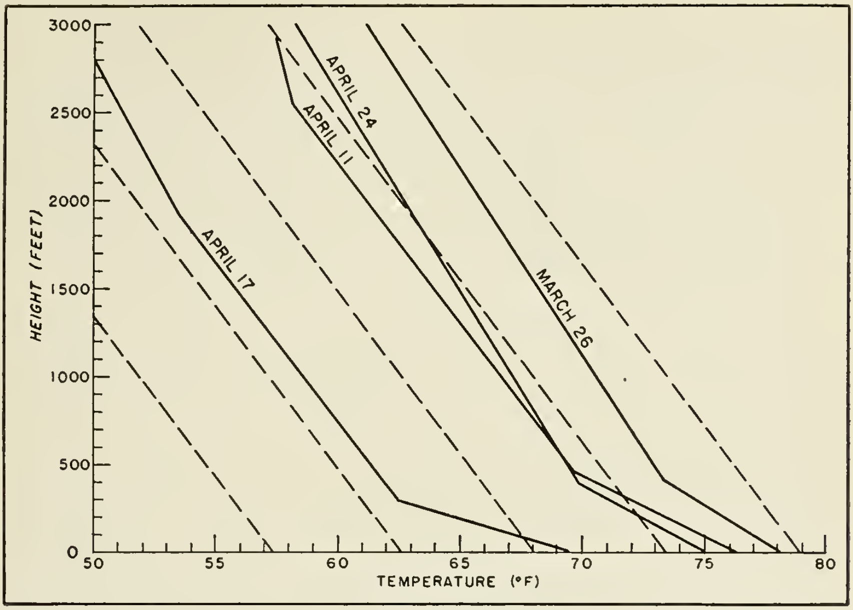

FIGURE 1.—Ten a.m. lapse rates for March 26, April 11, 17, and 24, 1950. The straight dashed lines represent the dry adiabatic lapse rates, i.e., a decrease of 0.53° F. per hundred feet in height.

less the instability. For example, on calm, clear nights, the air temperature often does not decrease with height but even increases. The atmosphere is then highly stable and the upward movement of smoke and heated gas may stop completely after reaching a certain height.

From the graph it will be seen that the unbroken lines, representing lapse rates for the 4 days, inclined sharply to the left of the dashed lines for a distance equivalent to a height of 300 to 500 feet. This means that layers of highly unstable air existed at these depths. These conditions of air turbulence, coinciding with certain fuel and stand conditions, and size of fire or rate of energy output, are believed to explain the strange fire behavior on the days mentioned.

There is usually some turbulence on clear sunny days, but the average value of the turbulence factor [2] is not known for the Coastal Plain in early spring. Its value may be somewhere between 20 and 50. In contrast, the turbulence factors for March 26, April 11, 17, and 24, were respectively 110, 160, 390, and 135. It is possible that there were other days during the spring season that had equally high turbulence factors, but whirls or erratic fire behavior were not observed. If highly turbulent days did occur, it may be that fires were controlled while small or before they

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[2] A turbulence factor T will be defined by the equation

$$T = 100 \left( \frac{L_e}{L_a} - 1 \right),$$

where $L_e$ is the existing lapse rate and $L_a$ is the dry adiabatic lapse rate. When $L_e = L_a$, the air is neutrally stable and $T = 0$. Whenever $T$ is greater than 0 there is always some turbulence.

reached the breaking point, or that they did not burn under the fuel and stand conditions most favorable to turbulence. Further analysis should clarify this point.

As has been pointed out previously, very severe fires can occur on days when the atmosphere is relatively stable. On March 27 the turbulence factor was only 16, but this was a severe fire day. As a result of high wind velocity—30 to 40 miles per hour with gusts reaching almost 60 miles per hour at the Charleston airport—there were intense, fast-spreading fires which did great damage. There was nothing erratic or baffling in their behavior, however, that could not be explained in terms of wind and fuel conditions.

When a fire burns in a stable atmosphere, the hot gases must not only expend energy as they lift their masses through the stable air, but they also expend part of their energy in dragging a part of the surrounding air upwards. The stable air acts like a ceiling so that on a calm clear evening the smoke rising above a fire will reach a certain height and then level off. The conditions are entirely different when a fire burns in an unstable atmosphere. The gases do not expend energy as they rise but in their ascent they may even acquire energy from the atmosphere. Their path upward creates a chimney into which the surrounding unstable air is drawn. The potential energy of the unstable air is then converted into kinetic energy as it enters the chimney created by the fire. When the total rate of energy release (rate of energy output of fire plus rate of energy change in the unstable atmosphere) is great enough, then whirls should develop.

## ATMOSPHERIC INSTABILITY AND DUST DEVILS

There appears to be similarity in some of the conditions which favor the development of whirls on some erratic fires and dust devils. These are strong surface heating on clear days, and winds of not more than moderate velocity. Ives (4) gives the following account of the conditions favorable for their formation.

> "In geographically favorable areas dust devils occur most frequently in clear weather, when the surface has been heated for some hours, and there is little surface wind. Under these conditions the surface air is very hot with respect to that a few hundred feet aloft . . . Typically favorable conditions, measured during a 'Great-Basin-High regime' are: surface temperature, 160° F.; one foot above surface, 142° F.; five feet above surface, 116° F.; 500 feet above surface, 100° F.; 2,000 feet above surface, 92° F. . . . "

Such a pronounced drop in temperature means, of course, an extremely unstable atmosphere near the ground. Ives further states that the upward velocity of the air in a dust devil may exceed 35 miles per hour and that measured horizontal winds within the whirl can accelerate from near zero to speeds of from 50 to more than 90 miles per hour and then return to their former velocity within 30 to 100 seconds. Velocities within the whirls on the southeastern fires are not known, but they are strong enough to carry burning embers for considerable distances ahead of the main fire.

Williams (5) gives the range in size for dust devils as varying from 20 to 200 feet in diameter and from 10 to 4,000 feet in height. It thus appears that the largest dust devils occupy an area only about one-tenth as great as the area of the larger whirls on the South Carolina fires. The main difference between dust devils and whirls on fires is that the former must obtain all of their energy from the potential energy of the atmosphere, whereas the latter obtain their energy from burning fuel as well as the atmosphere. In the same article Williams states:

> These occurrence times were from 1 to 5 hours before the times of maximum temperatures. The reason for this fact is that the wind speeds normally increase as the times of maximum temperatures are approached and certain critical speeds are reached beyond which the dust whirls cannot exist. These critical speeds have not yet been determined, but vary with lapse rate, topography, and probably other factors.

Brown (1) states that dust devils are an ominous sign to fire fighters. Whirls of a similar nature on fires may account for many blow-ups.

## LAPSE RATE IS RELATED TO FIRE CONTROL

If the conclusions reached regarding the effect of air turbulence on fire behavior are substantiated by additional work, a new aspect of fire control in the Southeast will have been recognized. Although erratic fires in this section may not be common, their potential danger to suppression crews and damage to timber stands, particularly in the younger age classes, will justify the taking of extra precautions during especially hazardous periods. Radiosonde observations, where available, will be helpful but the extent of the adjacent area to which these apply will have to be determined. Forecasts of high impending turbulence a day or two in advance would be most useful, although a forewarning of even a few hours might mean considerable for the safety of men and equipment. Suppression crews during such periods could be alerted to make the fastest possible attack so as to restrict any fire to the smallest possible acreage and before it reached the breaking point. In short, they could be warned to expect crowning and the sudden formation of large whirls, unusual backfire behavior, exceptional rates of spread considering existing wind velocities, gustiness and quick changes in wind direction. and the likelihood of danger even in making flank attacks.

It should be emphasized again that the changing fuel and stand types occurring in the Southeast may be a necessary condition for the large whirling fires which burned in South Carolina last year. These fires burned in dense stands of reproduction (predominantly loblolly pine) in which the compact crowns constituted the main source of fuel. In turn, the availability of this green fuel for combustion was increased by an unstable atmosphere plus a high rate of energy release in the ground fuels.

[Since this report was written, data have been obtained from the Weather Bureau which give the upper air temperatures at the Charleston airport for all days in the period from March 20 to April 30. Although a complete analysis has not yet been made, these data indicate that there were only eight days in this period with a highly unstable atmosphere. Four of these days were March 26, April 11, 17, and 24 when severe whirling fires occurred. On the other four unstable days, no whirling fires were reported. April 27, the atmosphere was very unstable at 10:00 a. m., but 0.41 inches of rain fell later in the day before 5:00 p. m. Similar turbulent conditions existed on April 6 and 27, but 0.33 inch of rain fell on April 5 and 0.60 inch on April 27 and 28. The chances were very slight for fires starting and building up to a high rate of energy output on these days, especially in dense stands of young loblolly pine. On April 19 there was a highly unstable layer of surface air but it was only 150 feet deep. In addition, the next layer above was deep and stable. It is doubtful if large whirling fires could develop on such a day. However, the shallow layer should have had a marked effect on the behavior of small fires. This additional evidence appears to corroborate some of the ideas advanced in the report.]

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## Smoke-Eaters at Work

A lot of people talk about forest fires. Down Joplin way, some people are doing something about it, under the supervision of that city's Natural Resources committee of the Chamber of Commerce, and under the leadership of Don Hunsaker, assistant manager of the Chamber.

The group of fire fighters, known as the Smoke-Eaters was organized in the spring of 1950, for volunteer forest protection and fought several fires last year. Last February, it was reorganized on a larger basis to help handle this year's burns. It now includes 30 men, divided into "telephone groups" of five or six under a group captain who calls up his team on instructions from Hunsaker. In addition, there are 50 to 100 emergency volunteers, while, for serious fires, arrangements have been made to mobilize the Boy Scout and Explorer Scout troops of Joplin.

All fire fighting is done under the jurisdiction and at the call of the Conservation Commission's forestry personnel. The Smoke-Eaters fight not only forest fires but field blazes also, and their creed is based on prevention of fires where possible.

Among the Smoke-Eaters are doctors, lawyers, bankers, newspapermen, Boy Scout heads, sporting goods retailers, salesmen, a retail store manager, a veterinarian, printer, publisher, florist, manufacturer, and many other professions. All of them are bound together by their interest in the natural resources of southwest Missouri; all have had some training under Martin Grau, farm forester from Monett, and District Forester Joe Range of Pineville.—From MISSOURI CONSERVATIONIST *April* 1951.

# SAFETY DEVICE FOR LOOKOUT TOWER LADDERS

Seth Jackson

*Administrative Officer, U. S. Forest Service, Washington, D. C.*

Tower ladder accidents are not frequent, but when one does happen it is usually serious, if not fatal. A new development in the safety field offers protection from this danger. It is a device which can be fastened to any tower ladder to protect the climber from a fall.

It consists of a 1-inch steel pipe bolted to the center of the rungs running the full length of the ladder. This can be fastened to a 100-foot tower by three men in about 2 hours. A bronze sleeve travels up and down the pipe when it is attached to the safety belt of a climber. The pipe is notched at about 6-inch intervals (fig. 1).

Operation of the device is very simple: The climber snaps his safety belt to the sleeve. He climbs in a normal position which automatically holds the lock open. In case he starts to fall, the device automatically locks in the next 6-inch notch, positively preventing the fall. The pipe does not interfere with climbing the ladder in the usual manner, if a person does not have a safety belt with him.

In the Northern States when there is ice danger, a car exhaust or propane tank and burner can be attached to the bottom of the pipe for de-icing, since the pipe is air-tight to the top. After attaching his belt to the sleeve, a towerman can then climb the icy rungs with perfect safety.

The installation costs about $225 for a 100-foot tower. It is manufactured in Burbank, Calif.

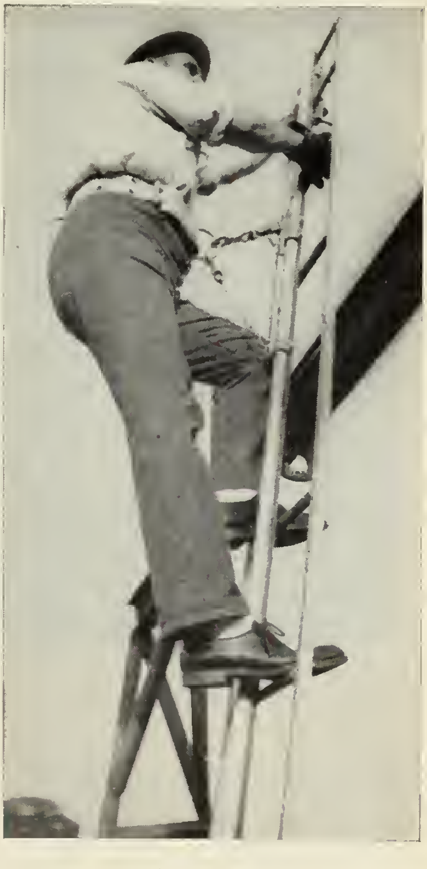

Figure 1.—Safety device in normal climbing position.

# RAILROAD TANK CAR

A. B. Everts

*Division of Fire Control, Region 6, U. S. Forest Service*

Railroad tank cars, which have wide and varied use throughout the United States, make effective fire suppression equipment. Many of the tank cars on logging operations use steam-operated piston-type pumps, and it is necessary that a locomotive be on hand to furnish the steam. The White River Division of the Weyerhaeuser Timber Company at Enumclaw, Wash., has three 8,000-gallon tank cars, each equipped with an independent pump and motor (fig. 1).

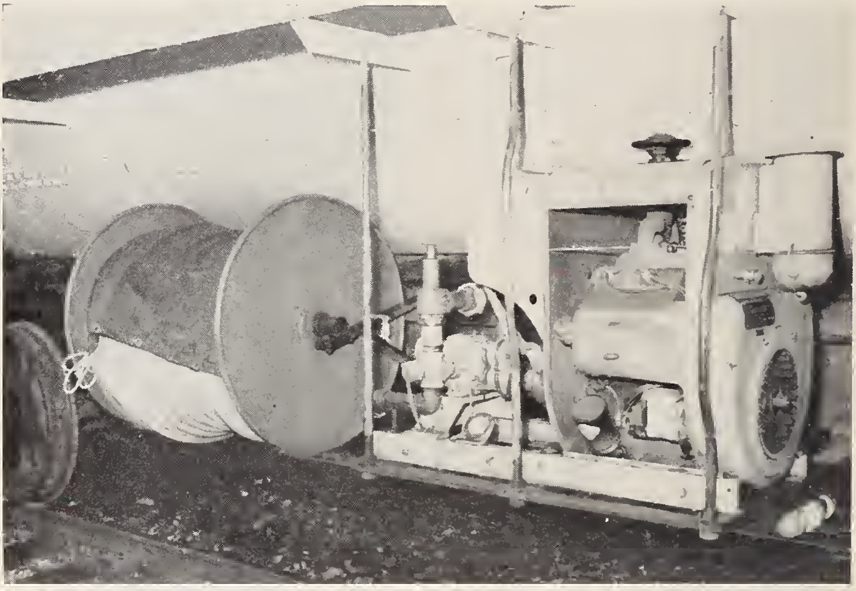

Figure 1.—Details of White River 8,000-gallon railroad tank car. Hose is carried on a dummy reel.

The advantage of the independent pump and motor is that a tank car can be spotted near a fire and used while the locomotive is doing other work. In addition, the pump is capable of delivering up to 89 gallons per minute at 100 pounds pressure. This means that three or four 1½-inch hose lines can be used, a much greater capacity than ordinarily can be obtained from piston-type steam pumps.

The 8,000-gallon tank cars are equipped with gear type pumps driven by 4-cylinder, V-type, air-cooled engines. The bypass is set at 150 pounds.

Pipe-line strainers are used to keep foreign matter out of the hose line, and 1,500 feet of 1½-inch CJRL hose are mounted on two or three dead reels. Also carried are three 1½-inch combination fog, straight-stream, and shut-off nozzles and two 1½-inch siamese valves. Other equipment to round out the tank car as a fire-fighting unit includes six shovels, six adz hoes, three axes, two saws, one backpack pump, and one pulaski. Extra gasoline, oil, pipe wrenches, and tools complete the unit (fig. 2).

[Fire Warden Monte Rodie, to whom the writer is indebted for the information for this article, insists that all fire equipment (the railroad tank cars are only a small part of the total in use) be kept in first-class condition and that woods crews know how to operate the various kinds.]

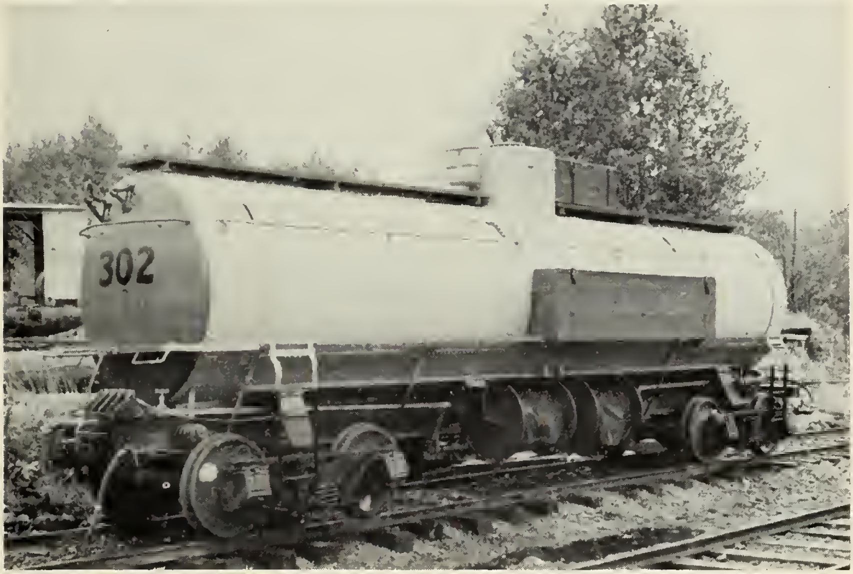

FIGURE 2.—White River tank car with dead reels and tool boxes. Pump and engine are on other side.

# HOSE TESTING AND DRYING RACK

Roy O. Walker
*Division of Fire Control, Region 6, U. S. Forest Service*

The regional fire cache in Portland, Oreg., carries a supply of fire-fighting equipment to back up project fires on the national forests in Oregon and Washington. Our plan calls for a minimum of 59,000 feet of 1½-inch hose. There have been times when all this hose has been out on fires. The job of washing, testing, drying, rolling, and storing this hose is a big one. The layout for doing this job is shown in figure 1.

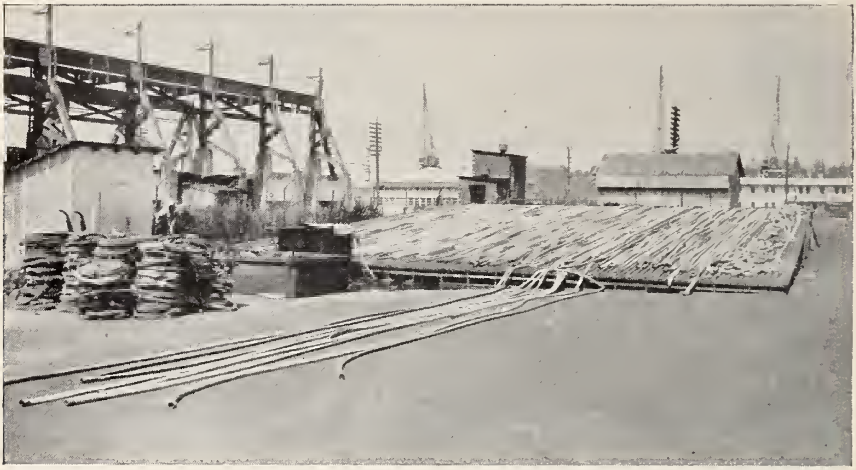

Figure 1.—Over-all layout and arrangement of hose washing, testing, and drying rack.

The steps in the process are as follows:

1. Dirty hose, loosely rolled, comes in from the fires.
2. The hose is then soaked in one of two 6- by 6-foot galvanized tanks, 27 inches deep, to loosen the dirt and grime.
3. After soaking, tie strings are removed and the female end is threaded through a "doughnut" hose washer and pulled out on the rack. The washer operates at 150 pounds' pressure, and hose is washed by the simple process of pulling it through the doughnut.[1]

4. The female end of the hose is then attached to the tester head shown in figure 2. It is not necessary to screw the coupling on to the water discharge; once the "gripper" arm is placed over the coupling and the cam lever pushed forward, the hose is held in place. The hose is tested at 225 pounds' pressure, read direct from the pressure gage.

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[1] For details of the doughnut hose washer, see January 1949 issue of FIRE CONTROL NOTES, p. 28.

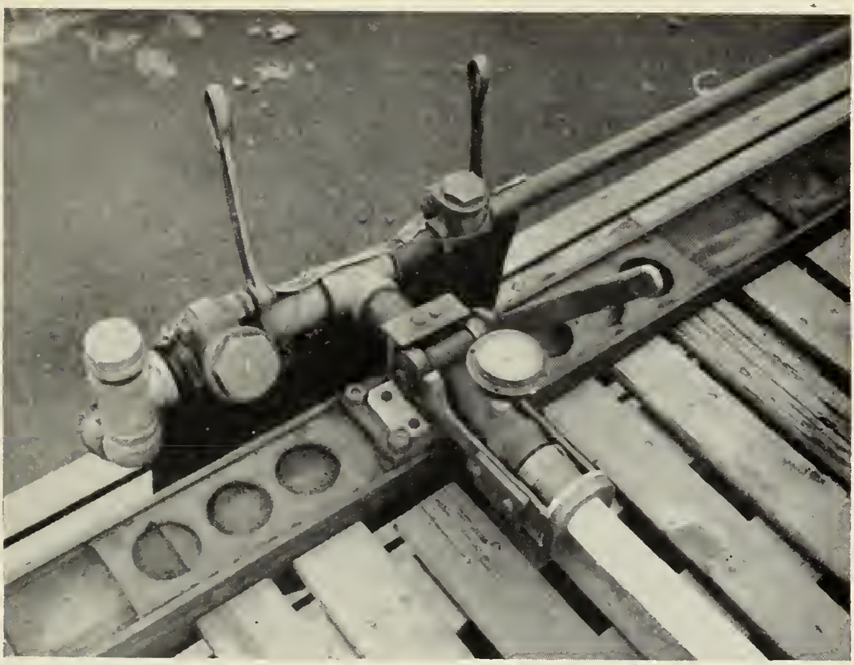

Figure 2.—Tester head. Cam lever in foreground operates "gripper" which holds female end of hose tight against discharge port. Coupling is not screwed on. Lever on left operates intake valve. Lever on right operates the release.

5. At the lower end of the rack, one man screws on 1½-inch caps, usually having a half dozen with which to work. These caps have 1/16-inch holes drilled in them to allow the air to escape.

6. The entire tester head moves on a track. Thus it is possible to start at one edge of the rack and work across as the male ends of the hose are capped at the bottom of the rack.

With this arrangement, two men can wash and test 15,000 feet of hose in 8 hours.

The hose rack is 58 feet long and 50 feet wide.

Pressure for testing is provided by a 2½-inch, electric-driven pump hooked up to the city water supply. Water from the pump goes direct to a high pressure booster tank equipped with a relief valve and bypass. One-and-one-half-inch hose runs from this booster tank to the tester head.

More detailed information is available for interested persons from Regional Forester, Post Office Building, Portland, Oreg.

# EJECTOR SUCTION BOOSTER

Arcadia Equipment Development Center
*Region 5, U. S. Forest Service*

"Water, water everywhere, but not a drop to drink." By changing the last word to "draft," we have a condition which is common to fire fighting in forest areas where numerous streams and lakes exist, but whose resources cannot be utilized without undue delay, because fire trucks cannot approach sufficiently close to draft water.

By using a very simple, inexpensive gadget, which we choose to call an eductor, but known also as an ejector or jet pump, matched to the pumper on the fire truck, water can be lifted 100 feet vertically; reservoirs 200 or 300 feet away can be tapped; or tanks can be refilled at twice the output of the pumper. In some instances, dirty sand-laden water from an existing sump could be utilized for pumping onto a fire at triple the pump's output, with no damage to equipment.

Eductors for operation with portable pumpers can be purchased at $7 to $25. They weigh 1¼ to 14 pounds, and have no moving parts to wear out or get out of order.

Eductors have been used in industry for years for elevating or mixing liquids by use of water under pressure as motive power. In 1949, the Arcadia Equipment Development Center secured numerous makes and sizes of eductors to determine their adaptability to forest fire fighting activity, and select the types best suited to pumpers commonly used (fig. 1).

Since eductors are not in common use on fire equipment, it might be well to explain the principle on which they operate. Water is pumped

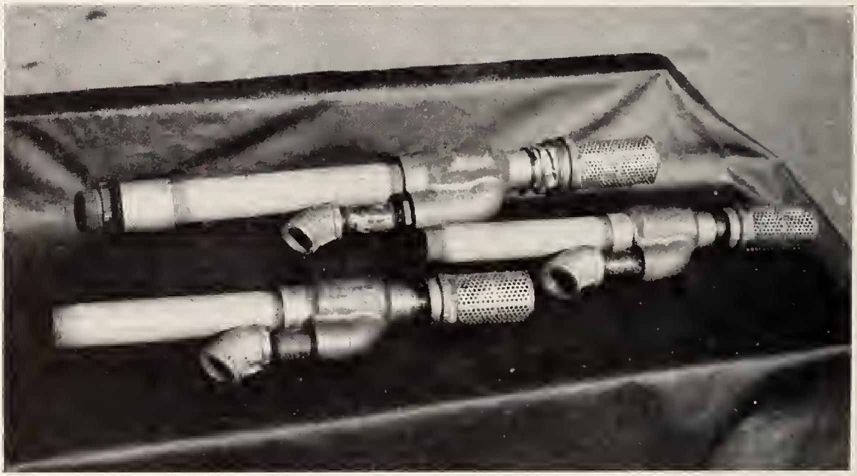

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Figure 1.—Three eductors used on tests.

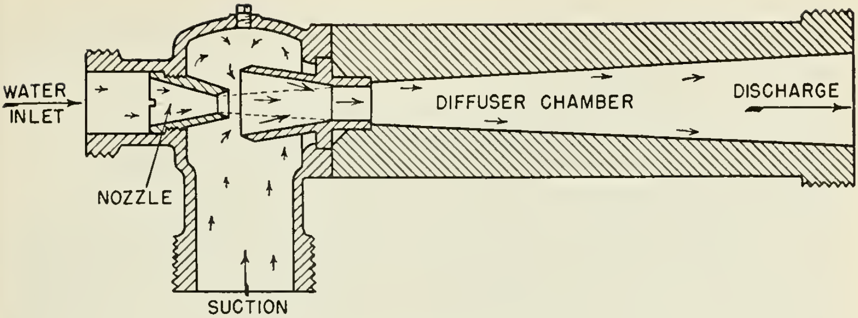

FIGURE 2.—Cross section of eductor.

through a built-in nozzle at high pressure into a diffuser chamber where extra water is picked up or entrained by the high velocity stream (fig. 2) just as a person's hat is dislodged by the passing of a fast-moving vehicle, due to so-called suction.

The eductor should be submerged in the pickup water for most efficient operation. However, a suction pipe or hose from the eductor to the water source will provide pick up of water at a reduced rate, depending on the suction lift. For trouble-free operation, the former operation method is recommended because no suction leaks are present to cause failure, all lines and connections being under pressure.

Recent checks of field operation of pumpers show that difficulty with suction is one of the most common field failures. In spite of manufacturers' claims, it is obvious that soon after use, pump suction ability drops off. As wear increases, a 10-foot lift is not uncommon as the maximum ability of a dry positive displacement pump. Add to this, failures due to leaky suction hose, loose connections, poor or wrong size gaskets, and losses due to elevation, and the drafting operation can present an infinite source of trouble.

In contrast to this, an eductor could minimize suction difficulties, since it operates under pressure. Suction hose might be eliminated. Leaks, if any occurred, would not cause failure.

Figure 3 shows the use of an eductor with the 160-gallon, ½- to 1-ton, slip-on pumper-tanker. The vehicle is located 80 feet above the water source, and the pump operating at 200 p.s.i. is delivering 20 g.p.m. Of the water pumped, 9½ g.p.m. is being delivered down hose line "A" to the eductor. The eductor is delivering 20 g.p.m. to the tank through line "B." Fog nozzle on line "C" is delivering 9 g.p.m. The unit will operate continuously under this condition, with occasional throttling of flow in line "A" to prevent overflow of the tank.

In order to operate without the eductor, a portable pumper would have to be set up at the water source. Not having a portable pumper would, in this particular location, require a round trip of 4¾ miles to allow the tanker to reach the water source and draft with usual hard suction hose. An alternative would be the use of two more tankers of the same size shuttling back and forth in order to keep the unit supplied with water for continuous operation.

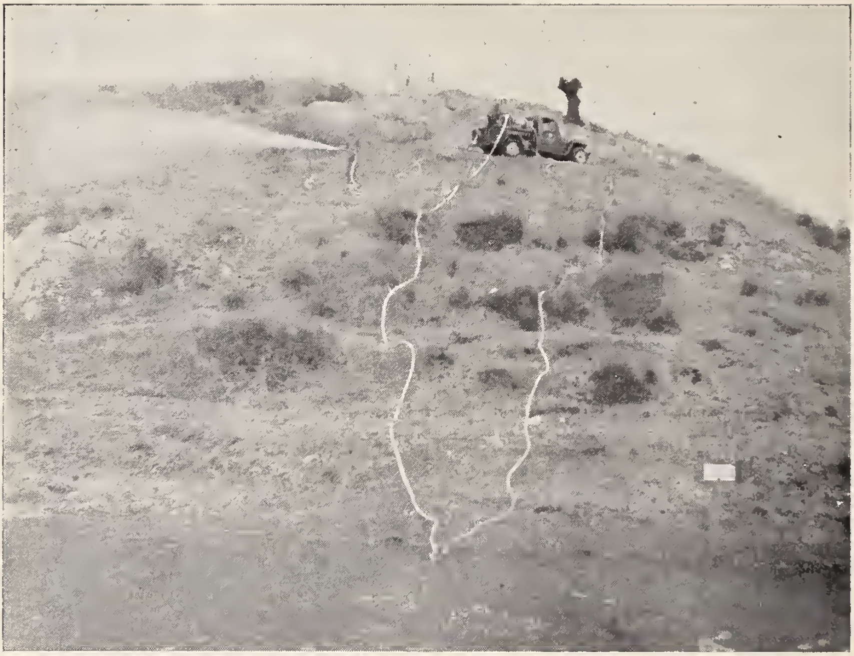

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FIGURE 3.—Eductor being used with 160-gallon, ½- to 1-ton, slip-on pumper-tanker.

Under test conditions, and on larger pumper-tankers, two eductors spaced along line "B" have been used to lift 180 feet.

Table 1 gives values obtained for two of the eductors tested and is an indication of the variation in operating conditions obtainable.

TABLE 1.—*Maximum output-lift for two eductors*

EDUCTOR E

| Pressure | Lift | Water to jet | Water from jet | Pickup water |
|---|---|---|---|---|
| *P.s.i.* | *Ft.* | *G.p.m.* | *G.p.m.* | *G.p.m.* |
| 150 | 35 | 13 | 44 | 31 |
| 200 | 46 | 15 | 46 | 31 |
| 250 | 70 | 17 | 47 | 30 |
| 250 | 100 | 17 | 22 | 5 |

EDUCTOR C

| Pressure | Lift | Water to jet | Water from jet | Pickup water |
|---|---|---|---|---|
| 150 | 45 | 13 | 34 | 21 |
| 200 | 57 | 15 | 36 | 21 |
| 250 | 80 | 18 | 37 | 19 |
| 250 | 100 | 18 | 33 | 15 |

The table shows that a pumper that is capable of pumping 17 g.p.m. could deliver 30 g.p.m. to the water tank, using water from supplies considerably beyond the range of suction drafting. It also indicates that if an eductor were wanted for rapid refill of a fire truck, eductor E would be the proper one to select for lifts up to 70 feet, but C would be selected for lifts of 100 feet.

If the local conditions were such that the primary use was for drafting from, say, a river which was beyond the range of suction lift, and pumping onto fires considerably higher in elevation, another eductor would be selected whereby approximately half of the pumper capacity would run the jet to keep the tank full, and the balance could be pumped onto the fire.

From this short discussion, it is quite evident that selection of "the best eductor" is dependent on certain basic conditions. Adjustable jets are manufactured which permit limited adjustments to overcome these obstacles, but they are complicated and expensive. It might not be out of reason to carry two, or even three, eductors on a fire truck, in order to get maximum performance for all conditions.

One difficulty which exists with the use of eductors for drafting is that some water must be available in the fire truck to start the operation of entraining pickup water. This can be accomplished by installing an auxiliary tank either in the tank or outside, which could be tapped for this purpose; or the internal dip pipe could be equipped with a valve which would not allow the tank to be drained in regular pumping operation, but which could be closed, so that the remaining water could be used for operating the eductor.

## SUMMARY

1. By using an eductor properly designed for the pumping unit, water can be pumped from a stream or reservoir which is 100 feet below the fire truck, or from sources 300 feet from possible accessibility because of soft ground, impassable terrain, fences, etc.
2. Output of pumpers can be increased considerably for filling the tank where lifts are 70 feet or less.
3. Where lifts are within range of drafting operations (15 to 20 feet), pumpers could utilize local water sumps and deliver two or three times the pump capacity onto a fire at low pressure.
4. Drafting failures can be minimized by using eductors.
5. Suction hose might be eliminated as necessary tanker accessory.
6. Eductors are inexpensive, simple to operate, and long lived.

Further details concerning the Ejector Suction Booster project and information concerning makes and types of eductors which can be used with pumpers up to 30 g.p.m. at 250 p.s.i. are available at the Arcadia Equipment Development Center, 701 N. Santa Anita Ave., Arcadia, Calif.

# PAPER-COVERED PILED SLASH

Lowell W. Ash

*District Assistant, Rouge River National Forest*

Each fall the Forest Service is likely to experience difficulty in burning piled slash. This is particularly true in the pine-fir transition forests of southern Oregon. Much depends upon favorable weather before, during, and after burning to insure a successful operation. Much labor and equipment has often been necessary to control fires which have gotten away as a result of drying weather conditions after too early slash burning. On the other hand, unsuccessful and expensive burning often occurs because of early and continued rainfall, or postponement of burning until conditions are unquestionably safe late in the fall.

It occurred to the author that this problem could be lessened if some form of inexpensive covering could be provided to protect the piles against excessive moisture until all normal danger of fire spreading to surrounding forest land was over. Hence, an experiment was carried out during the 1950 season, whereby piles were covered with paper as they were made during the summer period. The paper used was Kraft No. 30-30-30, long fibre, waterproof, double-coated, 72 inches wide, with 4,500 square feet per roll. It cost $14.25 per roll at Medford, Oreg.

The slash piles, averaging 6 by 8 feet in size, were covered with the paper when the pile was about three-fourths completed. The piece of paper was not extended down the sides of the pile; it was only large enough to extend to the perimeter at the point where the paper was added. No more than usual care was taken in making the piles compact. However, piles were well rounded before paper was placed on them to insure against low places which might serve to hold water in pockets rather than shed it. The additional slash, that is, the top one-fourth of the pile, held the paper firmly in place. The 600 slash piles constructed in this manner required two rolls of paper. The cost of paper was $28.50, or 4¾ cents per pile.

The 1950 fall precipitation was unusually heavy for southern Oregon, with a total of 6 inches in the slash area by October 19, the day the piles were burned. Two inches of this total precipitation fell the day before burning. Twenty of the piles were purposely left until December 7, at which time light snow was present and the total precipitation had reached 15 inches. While the latter piles started a little more slowly, all 600 burned up clean with little to no chunking. To burn the 600 piles required 4 man-days and 1½ barrels of planer shavings soaked with diesel oil.

It is felt the experiment has demonstrated that this method of protecting piled slash until safe burning conditions are assured promises substantial savings in the over-all job of slash disposal. These savings will result from the following factors: (1) Fewer man-hours are required to burn piled slash. (2) It eliminates present risk of fires escaping, which destroy trees or property and frequently result in excessive control costs. (3) The burning operation can be completed at a more convenient time for the forest manager, without the need for week-end overtime or the hiring of larger crews to do the job before the piled slash becomes too wet. (4) Planned slash disposal in the partial cut areas can be kept current, with resultant lowering of the over-all hazard, as there will be very little carry-over or unburned slash as a result of extremely wet burning season.

## Metallizing the Interior of Water Tanks As A Rust Preventive

The large number of water-using units that have come into the picture in recent years in forest fire control pose all agencies owning them with a problem of eliminating, as far as possible, corrosion and deterioration in the metal tanks themselves.

An item in the April 1951 issue of Fire Control Notes stressed the possibility of using rust preventive solutions or special paints for coating the interior of tanks. A method which has not yet been mentioned covers a metal spraying process known as "metallizing," which is available commercially under a number of different trade names.

The equipment required consists of a sand blaster, driven by compressed air; a metallizing gun which admits compressed air, oxygen, and acetylene; a three-line hose unit to control these gases; a wire holding stand which contains reels of the particular kind and size of wire being used, and from which it feeds into the gun; a set of three gages to control flow of the various gases; and a magnetic thickness gage, which determines the thickness of the metallized coating.

A continuous wire is fed through the heat of the oxo-acetylene flame, which at the proper temperature volatilizes the metal wire that makes up the spray material. The metal is driven onto the surface to be treated in the form of a liquid or molten spray. It cools and solidifies on the surface and makes a permanent coating. Through the use of copper, zinc, or stainless steel, the interior of water tanks can be made practically corrosion proof, and the cost is far less than rust resistant metals in the body of the tank itself.

The purpose of the sandblasting is twofold. It removes all oxides, dirt, greases, or other foreign material from the surfaces to be coated, leaving them clean and in proper condition to receive the metal coating; it also pits and roughens the surfaces assuring proper bonding of the spray as it strikes the treated surface.

Cost of treatment varies with the thickness of the coating, the metal being used, and the technique required for any particular job. Owner of the full kit of equipment can treat steel surfaces for 12 cents per square foot. Work can be done commercially at costs ranging from 19 cents to $1 per square foot. These figures are based on applications of zinc to a thickness of 0.010 inch.

Surfaces treated in this way become highly resistant to corrosion. Coatings of zinc on steel, thickness 0.010 inch, assure metal life of 30 years without further treatment. Almost any firm material can be metal-sprayed, including wood, leather, certain fabrics, glass, and ceramic materials.

The method is now in common use in the oil and chemical industries and has extended to uses such as coating of ships' hulls exposed to corrosive waters. In any case, surfaces so treated have a life of almost indefinite periods.—G. I. STEWART, *Supervisor, Forest Fire Experiment Station, Michigan Department of Conservation.*

# FUEL WEIGHTS ON THE OSCEOLA NATIONAL FOREST

David Bruce
*Forester, Southern Forest Experiment Station*

Fire damage and the fire suppression job are determined in part by how much flash fuel there is in an area. In the southern pine region, heavier fuels (over 1 inch in diameter) increase mop-up but have relatively small effect on the initial control job. In the longleaf-slash pine type, age of rough and stand density are commonly used as general indicators of amount of small fuel. Fuel samples collected in longleaf or slash pine stands on the Osceola National Forest in the winter 1944-45 show how variable the amount of fuel less than 1 inch in diameter can be when thus classified (table 1). Despite the variability, there are well-defined trends that show that these are useful categories.

Table 1.—*Average weight of fuel per acre for open and dense stands, Osceola National Forest,* 1944-45 [1]

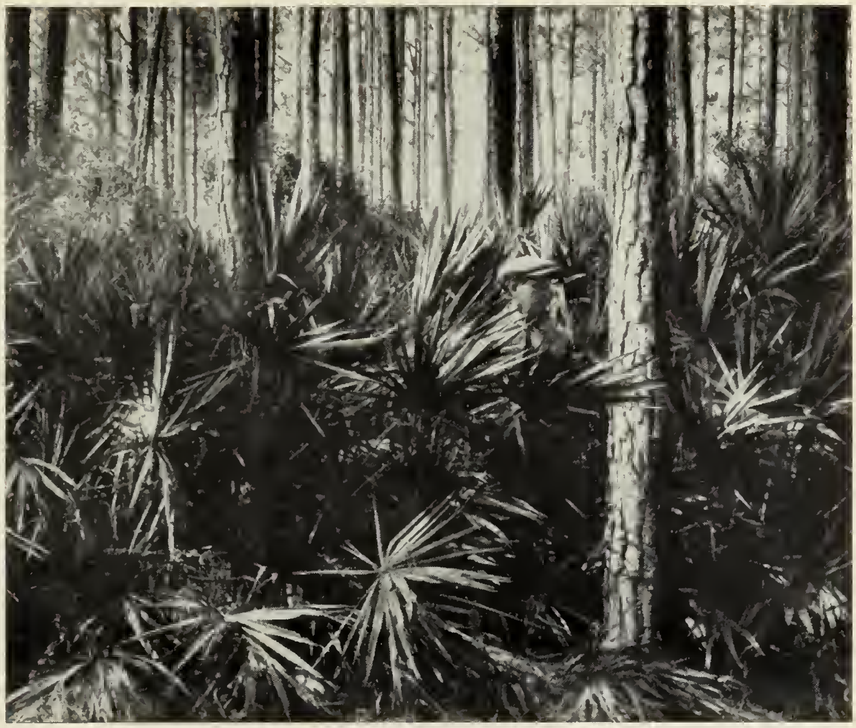
| Brush type | Open stands,[2] age of rough— | | | | Dense stands,[3] age of rough— | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 year | 2 years | 3-5 years | 10-15 years | 1 year | 2 years | 3-5 years | 10-15 years |
| | *Tons* | *Tons* | *Tons* | *Tons* | *Tons* | *Tons* | *Tons* | *Tons* |
| Palmetto and gallberry . . . | 2.5 | 7.5 | 4.8 | 8.4 | 6.8 | 8.9 | 9.7 | 10.5 |
| Palmetto only . | 3.7 | 6.3 | 4.1 | 7.2 | 6.3 | 8.3 | 9.0 | 20.8 |
| Gallberry only . | 4.4 | 5.8 | 5.1 | 7.5 | 8.0 | 8.8 | 8.2 | 13.0 |
| Average . . . . | 3.5 | 6.5 | 4.7 | 7.7 | 7.0 | 8.7 | 9.0 | 14.7 |
| No palmetto or gallberry . | 1.5 | 3.3 | 3.4 | 6.9 | 7.5 | 4.4 | 9.4 | 10.5 |

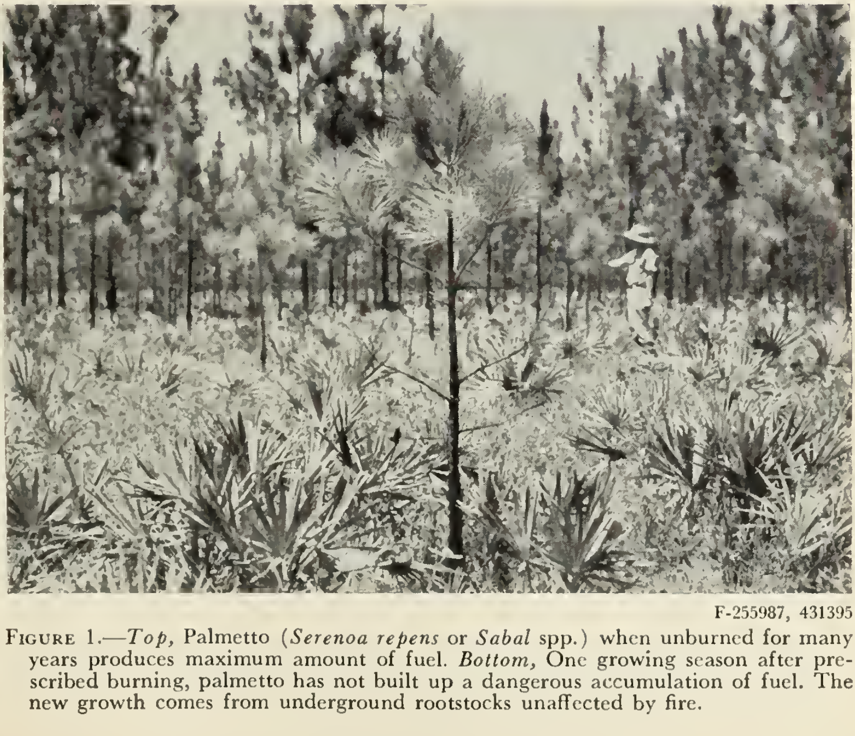
[1] Averages were based on air-dry weight of two samples of all material less than 1 inch in diameter that usually burn in headfires under dry conditions. Burnable material included dead palmetto leafstalks, but excluded green leafstalks, and living stems of shrubs and their branches 1/10" or larger in diameter. Each sample included all burnable material on a representative area 1 yard square.

[2] Light stands had no pines over 5 feet tall within 20 feet of the sampling area.

[3] Stands were classed as dense if within 10 feet of the sampling area there were at least four pines 4 inches d.b.h. or larger.

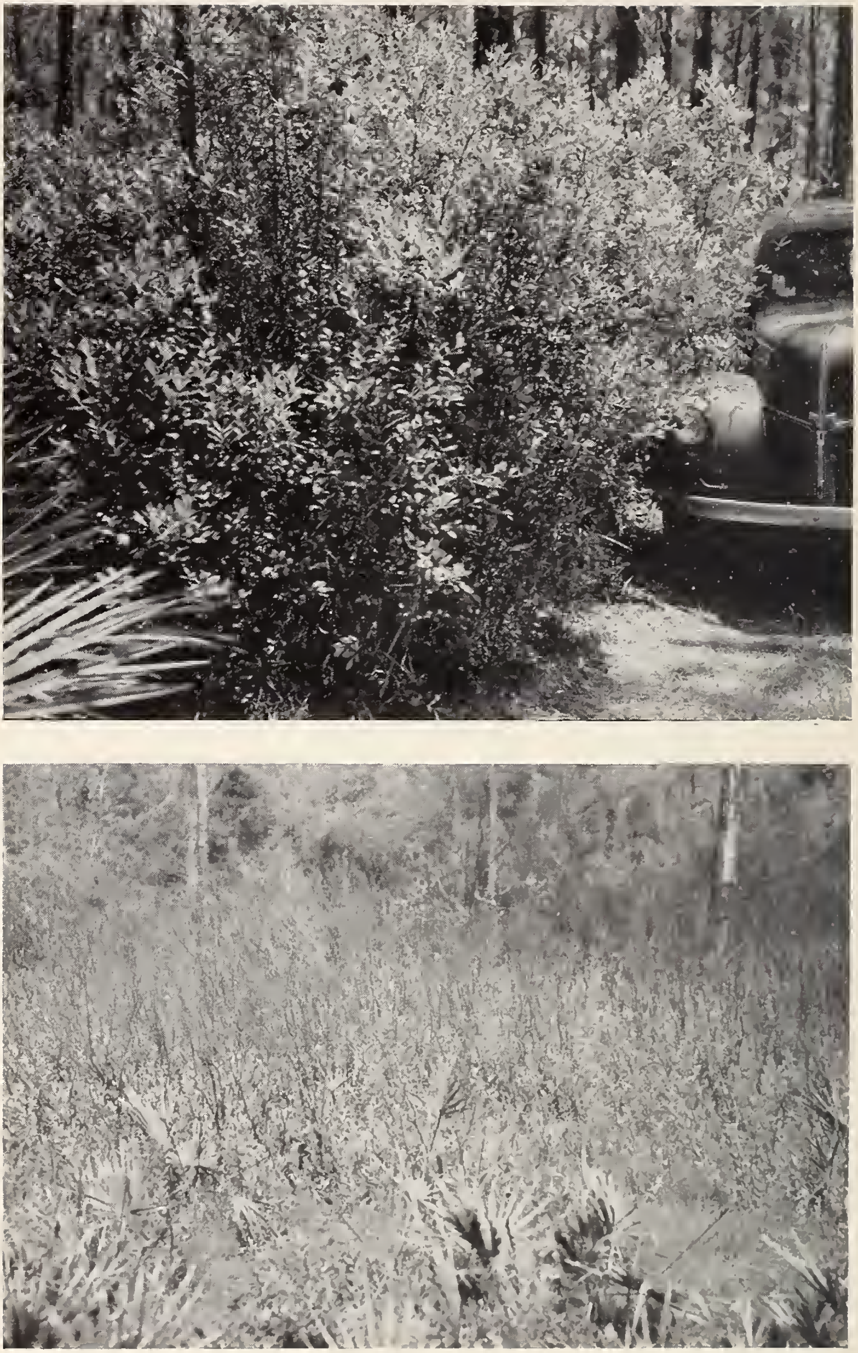
Dense pine stands (see footnotes to table 1) had on the average 4 tons per acre more fuel than open stands. For all density and brush classes, there were about 5½ tons per acre more fuel on the 10- to 15-year-old roughs than on 1-year roughs. Where palmetto or gallberry were present, there were 2 tons more fuel per acre than where these brush species were absent (figs. 1 and 2).





F-255987, 431395

FIGURE 1.—*Top,* Palmetto (*Serenoa repens* or *Sabal* spp.) when unburned for many years produces maximum amount of fuel. *Bottom,* One growing season after prescribed burning, palmetto has not built up a dangerous accumulation of fuel. The new growth comes from underground rootstocks unaffected by fire.



F-431349, 431388

FIGURE 2.—*Top,* Gallberry (*Ilex glabra*) unburned for many years is the plant associated with the next heaviest accumulation of fuel. *Bottom,* Like palmetto, gallberry sprouts vigorously the first season after prescribed burning, but it requires many years to regain the level in the upper view.

The highest and lowest average weights in the table, 20.8 tons and 1.5 tons, agree well with other measurements which indicate maximum fuel accumulations in dense stands of 25 tons per acre, and grass growth in the open of as much as 1 to 1½ tons per acre per year.

Within this range, however, there appear to be several inconsistent measurements. For example, there were greater fuel accumulations in some 2-year roughs than in some 3 to 5 years old, and in the 1-year roughs in dense stands there was more fuel with no palmetto and gallberry than with palmetto. This inconsistency arises in part from the fact that only 2 samples were taken per condition, but probably is even more due to differences in site and past fire history. Moist sites usually produce more vegetation than dry sites and hence accumulate more fuel, even though their decay rates may be slightly higher. For a given period after a fire, areas that have burned hard and often will accumulate less fuel than areas that have not burned frequently.

Where gallberry or palmetto were present they comprised over 40 per cent of the fuel in dense stands and about 60 percent in open stands. With no gallberry or palmetto, more than half the fuel in dense stands was pine needles, and two-thirds of the fuel in open stands was grass.

It is estimated that 50 to 90 percent of the total weights (of fuel less than 1 inch in diameter) sampled in open stands were rapid-drying flash fuels, that is, well aerated dry materials including material up to 1/10-inch diameter that burn rapidly in dry weather, while in dense stands the proportion was 40 to 70 percent. Little or no fuel was found more than 1 foot from the ground on one-year roughs or in areas with no palmetto or gallberry. The biggest increase in fuel more than 1 foot from the ground appears to come in the second year.

Chemical composition of fuel, its arrangement, and rate of change in moisture content were obviously different in the various tabulated conditions. These variables were not measured, but may be as important in their effects on fire intensity as the measured weights.

# LIGHTNING FIRES IN THE NORTHERN ROCKY MOUNTAINS

J. S. Barrows

*Chief, Division of Fire Research, Northern Rocky Mountain Forest and Range Experiment Station*

Lightning fires are a major problem in the northern Rocky Mountains. In the national forests of Region 1 over 75 percent of the fires are lightning-caused. An annual average of nearly 1,200 lightning fires occur on the national forests, and over 400 more occur on lands protected by other agencies. During the last 20 years these fires have burned nearly three-quarter million acres of forest and range land.

In some 40 years of organized fire protection in this region the various fire control agencies have made encouraging progress in their ability to deal effectively with this great load of lightning fires. Continued progress is essential and will depend largely upon gaining a thorough understanding of the nature and peculiarities of these fires. Recently, in an effort to provide this type of information, the Division of Fire Research made an analysis of over 25,000 lightning fires. In accordance with standard Forest Service procedure, essential data on these fires were coded and placed on punch cards to permit machine sorting and tabulating. By this method many factors influencing ignition, behavior, and control could be analyzed singly and collectively. The following are a few of the highlights of the study.

## THUNDERSTORM OCCURRENCE

Lightning produced during thunderstorms provides a violent source of heat to ignite forest fires. A lightning stroke may reach a temperature of 30,000° Centigrade. In the northern Rocky Mountains this tremendous surge of heat is seldom accompanied by the downpour of cooling and dampening rain normally associated with thunderstorms. During the summer months "dry" lightning is to be expected. These peculiarities of the storms, coupled with rough topography and large areas of dangerous fuels, are the underlying causes of the severe lightning fire problem in this region.

Thunderstorms cause fires during a 7-month period from April through October. As shown in table 1, during the 15-year period 1931-45 the region had an annual average of 88.13 thunderstorm days, counting only those storms which actually caused fires. In 1944 thunderstorms produced fires on 119 days between May 11 and October 28. During the summer months thunderstorm activity may be almost a daily occurrence. In 1940 lightning fires were started on 53 consecutive days from June 17 to August 8.

Thunderstorm activity reaches its peak in July when lightning fires occur on an average of 24.87 days. August is close behind with an average of 23.00 days, and June is third with 15.33 days. Occasionally a large number of storms may occur in May and September. During a 15-year period there were 2 years when May produced lightning fires on 15 or more days, and in September there were 5 years with this storm frequency. However, July and August are clearly the most dangerous months from the standpoint of lightning occurrence as well as more critical burning conditions.

TABLE 1.—*Number of days in each month, April through October, when lightning fires have occurred on National Forests in* R-1, 1931-45

| Year | April | May | June | July | August | Sept. | Oct. | Total |
|---|---|---|---|---|---|---|---|---|
| 1931 .... | 3 | 9 | 21 | 27 | 23 | 11 | 0 | 94 |
| 1932 .... | 0 | 5 | 9 | 15 | 22 | 6 | 1 | 58 |
| 1933 .... | 1 | 2 | 17 | 22 | 21 | 9 | 1 | 73 |
| 1934 .... | 5 | 16 | 17 | 25 | 14 | 8 | 1 | 86 |
| 1935 .... | 0 | 7 | 9 | 23 | 15 | 9 | 6 | 69 |
| 1936 .... | 1 | 13 | 18 | 25 | 27 | 12 | 1 | 96 |
| 1937 .... | 0 | 3 | 19 | 25 | 14 | 14 | 2 | 77 |
| 1938 .... | 0 | 5 | 15 | 21 | 18 | 17 | 3 | 79 |
| 1939 .... | 3 | 10 | 9 | 19 | 17 | 12 | 0 | 70 |
| 1940 .... | 0 | 9 | 23 | 31 | 26 | 26 | 0 | 115 |
| 1941 .... | 4 | 15 | 20 | 29 | 27 | 6 | 0 | 102 |
| 1942 .... | 0 | 8 | 9 | 28 | 30 | 20 | 4 | 99 |
| 1943 .... | 0 | 1 | 5 | 27 | 31 | 17 | 8 | 89 |
| 1944 .... | 0 | 9 | 20 | 30 | 29 | 23 | 8 | 119 |
| 1945 .... | 1 | 6 | 19 | 26 | 31 | 13 | 0 | 96 |
| Total .. | 18 | 118 | 230 | 373 | 345 | 203 | 35 | 1322 |
| Average. | 1.20 | 7.87 | 15.33 | 24.87 | 23.00 | 13.53 | 2.33 | 88.13 |

## OCCURRENCE DENSITY

Variability is the outstanding feature of lightning fire occurrence. In the national forests the 15-year average is 1,164 fires, but annual variations were found to run from a low of 270 to a high of 3,109 fires. More fires may occur in a 10-day period than normally occur in an entire year. In 1940 an all-time record of 1,488 fires occurred in the middle ten-day period of July. During the same period 335 lightning fires occurred in a 24-hour period—a greater number than occurred in the entire year of 1948.

Over 75 percent of the lightning fires occur in July and August. Normally, on about the tenth of July lightning fire activity increases rapidly and continues until a seasonal peak is reached about July 28. After this peak a remarkable midseason slump in occurrence during the first 10 days of August was noted in 11 out of 15 years. Then comes another build-up during the last 10 days of August reaching a peak slightly below that of July. During exceptional years there are great variations to this pattern. On two occasions well over 100 lightning fires occurred during the last 10-day period of May, and on one occasion over 300 fires occurred during the middle 10-day period of June. Late season peaks may likewise occur. Twice in 15 years loads of nearly 200 fires in 10 days came during September.

The bunching of great numbers of fires in a 24-hour period is a critical feature of lightning fire control. Regional loads of 50 or more fires in one day may occur in every month from May through September. During a 15-year period such loads were observed 2 times in May, 5 in June, 35 in July, 30 in August, and 4 in September. In July 1940 a regional load of 50 or more lightning fires occurred for ten consecutive days. On individual national forests loads of ten or more lightning fires in a single day were observed on 354 occasions in a 15-year period. In July 1938 the Kaniksu National Forest had 118 lightning fires in 24 hours. In July 1940 the Kootenai National Forest had more than 50 lightning fires on 3 days in a 10-day period.

The great variations in lightning fire occurrence and the peak loads dictate that flexibility be an essential feature of the fire control organization. Suppression forces must be capable of rapid mobilization to meet off-season loads and expansion to handle peak loads within the normal season. As in warfare, mobility and concentration of force are essential. To meet these requirements fire control planning must be on a regional basis. The cost of manning and equipping an individual forest to meet peak detection and suppression loads throughout a fire season would be prohibitive. Thus a pooling of forces is called for in a regional fire plan incorporating speed, coordination, and great flexibility of action.

## LIGHTNING ZONES

The old adage that lightning never strikes twice in the same place doesn't hold true in the northern Rocky Mountains. Contrary to this false belief lightning has struck hundreds of times in several distinct zones within the national forests. Some of the mountain tops are literally covered with the scars of lightning strikes.

In the national forests lying west of the Continental Divide the annual average is 51 lightning fires per million acres. However, in the zones of peak occurrence the annual average is over 175 fires per million acres. In one small zone of approximately 2,300 acres lying on the mountain tops of the Clearwater National Forest lightning fires have occurred at an average annual rate of 440 per million acres over a 15-year period.

These distinct lightning zones are caused by a combination of fuels and elevation. In general, high mountain areas covered with flammable fuels have much greater lightning fire occurrence than similar fuel areas lying at lower elevations. The most intense lightning fire occurrence zones in the high mountain areas are found in the national forests of northern Idaho. As shown in table 2, four of the five national forests in this part of the region have an average annual lightning fire occurrence greater than 100 fires per million acres in the 6000- to 7000-foot elevation zone.

TABLE 2.—*Average annual number of lightning fires*[1] *per million acres by elevation zones, national forests of northern Idaho,* 1936-44

| National forest | Elevation zone | | | | | | | Forest average |
|---|---|---|---|---|---|---|---|---|
| | 1000-1999 feet | 2000-2999 feet | 3000-3999 feet | 4000-4999 feet | 5000-5999 feet | 6000-6999 feet | 7000 feet & over | |
| Clearwater | ....... | 21.64 | 77.26 | 136.41 | 177.12 | 177.05 | 440.92 | 136.79 |
| Coeur d'Alene | ....... | 26.76 | 49.78 | 83.96 | 85.89 | 156.21 | ....... | 57.49 |
| Kaniksu | 7.36 | 29.60 | 53.11 | 62.70 | 87.30 | 123.19 | ....... | 53.93 |
| Nezperce | 10.76 | 26.78 | 39.75 | 74.57 | 109.78 | 98.56 | 66.90 | 74.46 |
| St. Joe | ....... | 52.01 | 39.95 | 60.51 | 80.49 | 190.59 | ....... | 63.93 |

[1] Basis: 7,377 fires.

The importance of fuels in governing lightning fire occurrence is illustrated in the national forests lying east of the Continental Divide. Here the most intense lightning fire zone is at the lowest elevation where fuels are principally ponderosa pine and grass. In this part of the region the mountain top areas often have only scattered areas of flammable fuels interspersed with rocky outcroppings and alpine meadows. The average annual lightning fire occurrence per million acres in the national forests lying east and west of the Continental Divide is as follows:

| | *Average annual lightning fire occurrence per million acres* | |
|---|---|---|
| Elevation zone (feet): | *Eastern Forests* | *Western Forests* |
| 1000-1999 | .... | 10.95 |
| 2000-2999 | .... | 32.53 |
| 3000-3999 | 30.45 | 50.79 |
| 4000-4999 | 8.10 | 66.99 |
| 5000-5999 | 10.12 | 73.72 |
| 6000-6999 | 6.96 | 69.26 |
| Over 7000 | 5.53 | 36.00 |

Snags are highly vulnerable to lightning fires. In a study of nearly 12,000 fires it was found that over three times as many fires started in snags as in green tree tops. The ratio of snags to green trees is not known. However, there are obviously a much larger number of green trees than snags in the forests of this region. Therefore, in view of the higher ignition rate in snags, they are clearly an important factor. This relationship is further illustrated by the fact that old burns where snags predominate have an average annual occurrence rate of 190 fires per million acres as compared to 40 in green forests.

## LIGHTNING FIRE DETECTION

In planning detection operations the daily period of peak fire occurrence is an important consideration. Lightning may strike and cause fires at any hour of the day. However, in the northern Rocky Mountains the late afternoon and early evening hours are clearly the period of greatest lightning occurrence, while the midmorning hours have the least lightning activity. The most important 8-hour period is from 2 to 10 p. m. In the national forests west of the Continental Divide over 60 percent of the lightning fires occur during this period. Concentration during these hours is even more intense on the forests east of the divide where 75 percent of the lightning fires occur between 2 and 10 p. m. Peak occurrence in both zones is from 4 to 6 p. m. Night detection is more important than generally recognized. More lightning fires occur during the hours of darkness than during the morning daylight hours.

Lookouts are more efficient in detecting lightning than man-caused fires. Over 83 percent of the lightning fires falling within the seen area of manned lookouts are first discovered from those stations as compared to only 43 percent for man-caused fires. However, speed of detection is slower for lightning than man-caused fires. Elapsed time from origin to discovery is greater than 12 hours for 45 percent of the lightning fires as compared to only 25 percent for man-caused fires. Likewise, nearly twice as many lightning fires are hangovers with a discovery time of over 48 hours.

This study of lightning fire detection has shown the importance of taking a fresh look at hours of work for detectors and general detection methods. The afternoon and early evening hours are normally the most important for detectors to be on the job. To increase the efficiency of night as well as daylight detection fire finders equipped with accurately calibrated azimuth and vertical scales need to be used in conjunction with matched panoramic photographs. Because of the difficulty of night detection a thorough scanning of the country is essential in the early daylight hours and especially during periods of critical fire weather. On aerial detection units it is important for aircraft and pilots to be capable of making safe flights after storms during the late afternoon and early evening hours when turbulent air may prevail. In all cases it is essential to correlate the detection plan with a system of measuring and rating fire danger in order to economize on detection costs and to promote efficiency.

## LIGHTNING FIRE SUPPRESSION

On the national forests over 84 percent of the lightning fires are held to class A size. In spite of this good record lightning fires present many special and difficult suppression problems. The average size per lightning fire is 46 acres. Only 4 percent of these fires can be reached by roads. The balance requires at least a part of the travel by other means. Only 34 percent of the lightning fires are reached within 1 hour. Over 22 percent of the lightning fires require more than 4 hours travel time, and 11 percent require more than 8 hours. Nearly 50 percent involve travel distances of over 5 miles and 25 percent over 10 miles.

The smoke jumper organization, designed primarily to control backcountry lightning fires, has made a good record in holding burned area to a minimum. The average size per smoke-jumper lightning fire is 11 acres. However, it is recognized that this record has been made during a 10-year period of phenomenally easy fire danger. In every dangerous or critically dry season in the region's history lightning fires have escaped control to burn large areas. On two occasions during the past 20 years individual lightning fires have reached sizes of over 75,000 acres, and on one occasion over 175,000 acres. During the same period over 100 lightning fires reached class E size.

While the smoke jumper has reduced the probability of disastrous burns in the future, the lightning fire suppression problem is far from being solved. The smoke jumper is primarily a hand-tool firefighter and operates under the same handicaps as any smokechaser. Ten years' experience has shown that 18 percent of the smoke jumper lightning fires are in high or extreme rate-of-spread fuels and that 11 percent of these fires are running, spotting, or crowning at first attack. Successful control of such fires demands something more powerful than hand-tool firefighting. The backcountry fire control man, like the infantryman, needs help. Future fire research and equipment development must point toward the improvement of basic fire suppression methods.

# A TEMPLATE FOR PREPARING AND CHECKING FIRE REPORTS

G. M. Wilkinson
*Assistant Forest Supervisor, Kisatchie National Forest*

In the Southern region of the U. S. Forest Service the dispatcher gathers the pertinent information and prepares the individual fire report, Form 929. The report is approved by the district ranger, forwarded to the supervisor's office where it is checked for errors, and then sent to the regional office for completion.

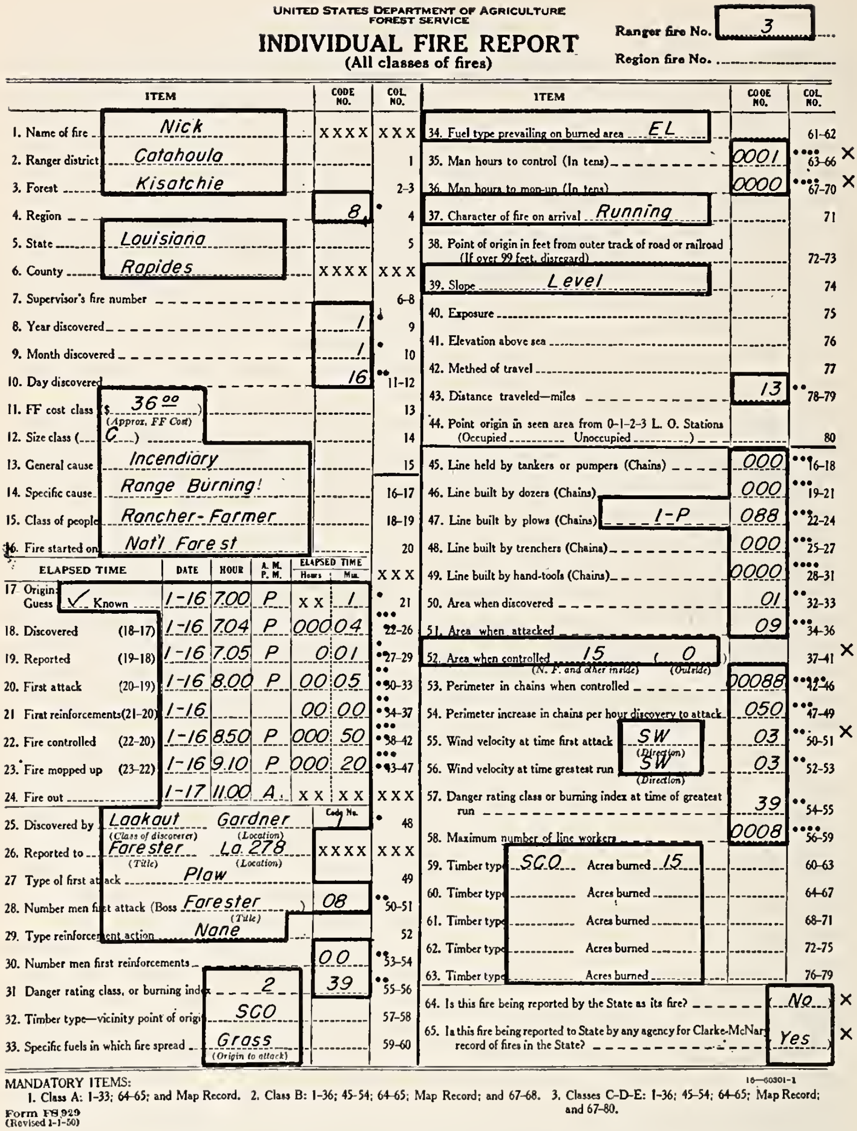
The fire report carries a "Code Number" column where information is coded for use on an IBM punch card machine. All national forest fire statistics are maintained on punch cards in the Washington office. Some of the information coded is placed on the report in the field offices and some at supervisor or regional offices. This made fire reporting by the field offices rather difficult and time consuming since it was necessary to constantly refer to voluminous instruction.

To assist field officers with this problem a template of clear plastic was designed with openings in the "Item" and "Code Number" columns where entries were to be made by the reporter. This template can also be used in the supervisor's office for checking reports prepared on the ranger districts. This device proved to be satisfactory and, while no studies have been made locally of time saved by its use, it has saved some time, and fire reports from the field are generally correctly prepared.

*Directions for using template.*—Place template over blank Form 929. Complete only the spaces where there is an opening in the template. Where the opening occurs over a line in the "Item" column, the information is written there; where the opening is in the "Code Number" column, the information, coded, is placed there. In one or two instances, openings occur in both columns and in such cases both entries are made.

The black dots at the right of the template openings in the "Code Number" column indicate the number of digits required for proper coding. For instance, item 10 requires two digits in the code column; item 53 requires five. The only exception occurs in items 18 to 23. These items require a code number in both the hours and minute columns. The black dots for these items are in two lines, the upper row indicating the number of digits (code) required in the hours column, the lower row indicating the number of digits required in the minutes column. Thus, if elapsed time on line 20 is 1 hour 55 minutes, it would be coded 01 in the hours column (two dots), and 55 in the minutes column (two dots).

For Class A fires complete all uncovered items on left side of template (items 1-33 )and all items marked × on the righthand side (items 35, 36, 52, 55, 64, 65). For Class B, C, D, and E fires complete all items uncovered by the template.



UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

INDIVIDUAL FIRE REPORT
(All classes of fires)

Ranger fire No. 3
Region fire No. ......

| Item | | Code No. | Col. No. |
|---|---|---|---|
| 1. Name of fire | Nick | XXXX | XXX |
| 2. Ranger district | Catahoula | | 1 |
| 3. Forest | Kisatchie | | 2–3 |
| 4. Region | | 8 | • 4 |
| 5. State | Louisiana | | 5 |
| 6. County | Rapides | XXXX | XXX |
| 7. Supervisor's fire number | | | 6–8 |
| 8. Year discovered | | 1 | • 9 |
| 9. Month discovered | | 1 | • 10 |
| 10. Day discovered | | 16 | •• 11–12 |
| 11. FF cost class ($ $36^{\underline{00}}$) (Approx. FF Cost) | | | 13 |
| 12. Size class (C) | | | 14 |
| 13. General cause | Incendiary | | 15 |
| 14. Specific cause | Range Burning! | | 16–17 |
| 15. Class of people | Rancher-Farmer | | 18–19 |
| 16. Fire started on | Nat'l Forest | | 20 |

| Elapsed time | Date | Hour | A. M. P. M. | Elapsed time Hours | Min. | |
|---|---|---|---|---|---|---|
| 17. Origin: Guess ✓ Known | 1-16 | 7.00 | P | xx | 1 | • 21 |
| 18. Discovered (18–17) | 1-16 | 7.04 | P | 000 | 04 | ••• 22–26 |
| 19. Reported (19–18) | 1-16 | 7.05 | P | 0 | 01 | •• 27–29 |
| 20. First attack (20–19) | 1-16 | 8.00 | P | 00 | 05 | ••• 30–33 |
| 21 First reinforcements (21–20) | 1-16 | | | 00 | 00 | ••• 34–37 |
| 22. Fire controlled (22–20) | 1-16 | 8.50 | P | 000 | 50 | •••• 38–42 |
| 23. Fire mopped up (23–22) | 1-16 | 9.10 | P | 000 | 20 | •••• 43–47 |
| 24. Fire out | 1-17 | 11.00 | A. | xx | xx | XXX |

| | | Code No. | Col. No. |
|---|---|---|---|
| 25. Discovered by | Lookout (Class of discoverer) Gardner (Location) | 7 | • 48 |
| 26. Reported to | Forester (Title) La. 278 (Location) | XXXX | XXX |
| 27 Type of first attack | Plow | | 49 |
| 28. Number men first attack (Boss Forester (Title)) | | 08 | •• 50–51 |
| 29. Type reinforcement action | None | | 52 |
| 30. Number men first reinforcements | | 00 | •• 53–54 |
| 31 Danger rating class, or burning index | 2 | 39 | •• 55–56 |
| 32. Timber type—vicinity point of origin | SCO | | 57–58 |
| 33. Specific fuels in which fire spread | Grass (Origin to attack) | | 59–60 |

| Item | | Code No. | Col. No. | |
|---|---|---|---|---|
| 34. Fuel type prevailing on burned area | EL | | 61–62 | |
| 35. Man hours to control (In tens) | | 0001 | •••• 63–66 | × |
| 36. Man hours to mop-up (In tens) | | 0000 | •••• 67–70 | × |
| 37. Character of fire on arrival | Running | | 71 | |
| 38. Point of origin in feet from outer track of road or railroad (If over 99 feet, disregard) | | | 72–73 | |
| 39. Slope | Level | | 74 | |
| 40. Exposure | | | 75 | |
| 41. Elevation above sea | | | 76 | |
| 42. Methed of travel | | | 77 | |
| 43. Distance traveled—miles | | 13 | •• 78–79 | |
| 44. Point origin in seen area from 0-1-2-3 L. O. Stations (Occupied ...... Unoccupied ......) | | | 80 | |
| 45. Line held by tankers or pumpers (Chains) | | 000 | ••• 16–18 | |
| 46. Line built by dozers (Chains) | | 000 | ••• 19–21 | |
| 47. Line built by plows (Chains) | 1-P | 088 | ••• 22–24 | |
| 48. Line built by trenchers (Chains) | | 000 | ••• 25–27 | |
| 49. Line built by hand-tools (Chains) | | 0000 | •••• 28–31 | |
| 50. Area when discovered | | 01 | •• 32–33 | |
| 51. Area when attacked | | 09 | ••• 34–36 | |
| 52. Area when controlled | 15 (N. F. and other inside) ( 0 (Outside)) | | 37–41 | × |
| 53. Perimeter in chains when controlled | | 00088 | ••••• 42–46 | |
| 54. Perimeter increase in chains per hour discovery to attack | | 050 | ••• 47–49 | |
| 55. Wind velocity at time first attack | SW (Direction) | 03 | •• 50–51 | × |
| 56. Wind velocity at time greatest run | SW (Direction) | 03 | •• 52–53 | |
| 57. Danger rating class or burning index at time of greatest run | | 39 | •• 54–55 | |
| 58. Maximum number of line workers | | 0008 | •••• 56–59 | |
| 59. Timber type SCO Acres burned 15 | | | 60–63 | |
| 60. Timber type ...... Acres burned ...... | | | 64–67 | |
| 61. Timber type ...... Acres burned ...... | | | 68–71 | |
| 62. Timber type ...... Acres burned ...... | | | 72–75 | |
| 63. Timber type ...... Acres burned ...... | | | 76–79 | |
| 64. Is this fire being reported by the State as its fire? | | (No) | | × |
| 65. Is this fire being reported to State by any agency for Clarke-McNary record of fires in the State? | | (Yes) | | × |

MANDATORY ITEMS:
1. Class A: 1–33; 64–65; and Map Record. 2. Class B: 1–36; 45–54; 64–65; Map Record; and 67–68. 3. Classes C-D-E: 1–36; 45–54; 64–65; Map Record; and 67–80.

16—60301-1

Form FS 929
(Revised 1-1-50)

FIGURE 1.—Template in place for checking fire report prepared in field. Note error in the code number column disclosed by template; item 51 should be coded 009.

*Directions for making template.*—(1) Prepare a pattern by blocking out on a blank 929 each line in the "Item" column and each line in the "Code Number" column which, under existing instructions, is to be reported on by the ranger district.

(2) With knife or razor blade, remove blocked out sections, leaving sufficient marginal material so the pattern will remain in one piece. Recheck pattern for accuracy before cutting template.

(3) Select a piece of clear plastic the same size as Form 929. Plasticiele, 30/1000 inch in thickness, is entirely satisfactory. In this weight, the

material is sufficiently rigid for the purpose, and yet is not too difficult to cut. Place the sheet of plastic over the pattern, lining up the edges of the plastic and the pattern. Then fasten to a table or drawing board with tape. Using a straightedge, score the outline of each opening in the pattern on the plastic. A sharp ice pick makes a good tool and the scoring should be deep. After this has been completed on one side, turn plastic sheet over and score the reverse side. If the scoring on each side is deep enough, the section to be removed can be broken out. Edges should be smoothed with an emery board or small file.

(4) If desired, the number of digits needed in the "Code Number" column can be indicated by dots, as shown on the template illustrated in figure 1. This information is also available in the "Column Number" column on the 929 and may be read direct. For instance, opposite item 10, the figures 11-12 appear in the "Column Number" column indicating two digits required in the "Code Number" column; opposite item 53 the numbers 42-46 appear, indicating 5 digits required. We have found the use of dots to indicate the number of digits to be more satisfactory.

This device has been tested under field conditions in Region 8 and approved for region-wide use. It can be adapted easily to the needs of the several Forest Service regions by changing the pattern to coincide with regional instructions. Its use should save time and improve accuracy in preparing and checking fire reports in the field.

While this discussion has been devoted to the use of the template in conjunction with Forest Service fire reports, it is possible that the idea could be applied to preparation of reports by other fire control agencies.

# BATTERY CONSUMPTION BY LOOKOUT-REPEATER TYPE RADIOPHONE

Willie I. Haynes
*Radio Technician, Region 7, U. S. Forest Service*

"It must take an awful lot of batteries to keep these things in operation," is the usual remark after someone inspects the "works" of the new FM radiophones with automatic repeaters now in use on the Jefferson and George Washington National Forests. The "works" is comprised of 13 or 14 relays, many transformers, resistors, etc., and from 28 to 30 tubes that range in size from that of a half-burned cigarette to the size of an average thumb.

Actually, the FM lookout station radiophones with automatic repeaters are conservative battery consumers. This point could have been proved in a scientific manner with fancy graphs, but due to many factors, such as variations in battery quality, shelf life of batteries, and atmospheric conditions that affect batteries, it was felt exact information might be misleading. Therefore, our method was simply that of comparing the number of battery replacements with the general use the radiophones received from time of installation in 1949 (two installed in 1948) until the close of the 1950 fall fire season on the two forests.

In Region 7, FM radio equipment is not used as it is in some of the other regions of the Forest Service. For example:

1. It is not used on a year-round basis for both administrative and fire control purposes. It is used only for fire control which includes presuppression and suppression communications in the regular forest fire seasons.

2. Radio, on the two national forests equipped with FM radiophones, is used intermittently during approximately 4½ months each year. The period of forest fire danger is divided into two seasons, one beginning in the spring about March 1 and ending about May 15, and the other beginning in the fall about October 15 and ending about December 15. The lookout stations are manned during these seasons on days of Class 3 and higher fire danger. The number of these days in the spring season varies, but the usual number is from 50 to 60 while in the fall it may be as high as 32. In other words, radio is used between 80 and 90 days each year.

3. Radio, of course, is only used when the lookout towers are manned. If the day starts with a Class 2 fire danger and increases to a Class 3, the stations on continuous stand-by operate on a schedule until the fire danger reaches a Class 3 day. This sometimes reduces the continuous stand-by period to 4 hours per day of Class 3 danger.

4. As a rule only key lookout stations on each district are on stand-by on Class 3 and higher fire dangers. The lookout stations of secondary importance are operated on a schedule. They go on stand-by for 10-minute periods every 30 minutes to receive messages from the key stations or to transmit when necessary. These stations go on continuous stand-by when (a) the fire danger reaches Class 4; (b) when personnel working in the vicinity need the station as a means of contacting the district offices.

5. Coded signals of the ten-series type are used on two districts of Jefferson National Forest. The forest plans adoption of these signals over the entire forest by the spring of 1951. Because of their brevity, coded signals permit the transmission of routine messages but reduce transmission time and resulting battery consumption.

To the outsider who is not familiar with Region 7, it may appear that the use of radio is considerably restricted. This is actually not the case. The forests using the FM equipment were responsible for developing the systems and methods in use, and have adopted them to meet their needs. Their objective is to conserve the batteries until they are needed most, which is on a forest fire.

With the foregoing information on how radio is used in Region 7, it is easier to evaluate the results of the survey made at the close of the 1950 fall fire season. Table 1 shows only the number of replacement batteries and does not include the original batteries when the radiophones were installed. If a replacement is not indicated opposite the name of a station, the original batteries are still in use.

On the basis of the survey of the number of battery replacements, we believe it can safely be said that even though the FM lookout radiophones have approximately four times as many tubes as the AM lookout station radiophones, they are twice as easy on batteries.

TABLE 1.—*Number of battery replacements for FM lookout station radiophones with repeaters, after installation in* 1949 *until close of* 1950 *fall fire season, at stations on two* R-7 *forests*

GROUP A [1]

| Station | Radiophone installation date | Receiver A | Audio A | Receiver B sets | Transmitter A | Transmitter B sets |
|---|---|---|---|---|---|---|
| On continuous stand-by: | | | | | | |
| High Knob .... | Aug. '49 | 0 | 0 | 0 | 0 | 0 |
| Quebec ........ | Mar. '49 | 1 | 1 | 2 | 1 | 1 |
| Walker Mountain | Nov. '48 | 2 | 1 | 1 | 1 | 1 |
| Apple Orchard . | Mar. '49 | 1 | 0 | 1 | 1 | 1 |
| Bald Mountain . | Sept. '49 | 1 | 0 | 0 | 1 | 0 |
| Duncan Knob .. | Oct. '49 | 0 | 2 | 2 | 0 | 2 |
| On a schedule: | | | | | | |
| Olinger Top ... | Aug. '49 | 0 | 0 | 0 | 0 | 0 |
| Jasper Cliff .... | Aug. '49 | 0 | 0 | 0 | 0 | 0 |
| Feathercamp ... | Mar. '49 | 1 | 0 | 0 | 1 | 0 |
| Flat Top ...... | Nov. '48 | 1 | 0 | 1 | 2 | 1 |
| Jones Knob .... | Mar. '49 | 1 | 0 | 1 | 1 | 1 |
| Allen Field ..... | Sept. '49 | 0 | 0 | 0 | 0 | 0 |
| Brushy Mountain | Oct. '49 | 0 | 0 | 0 | 0 | 0 |

GROUP B

| Station | Radiophone installation date | A battery sets | B battery sets |
|---|---|---|---|
| On continuous stand-by: | | | |
| Bald Knob .... | May '49 | 2 | 2 |
| Morning Knob . | Oct. '49 | 2 | [2] 0.4 |
| On a schedule: | | | |
| Earn Knob .... | Sept. '49 | 0 | 0 |

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[1] Because the radiophones are the product of two manufacturers, the battery complements are different, and the table is grouped accordingly.

[2] 10 to a set.

# FIRE DANGER MANNING GUIDE

MERVIN O. ADAMS
*Forest Dispatcher, Shasta National Forest*

During the past 2 years, the Shasta National Forest has been operating its fire force, on off-duty days, through the use of a Fire Danger Manning Guide.

This guide was designed by Dispatcher Adams to eliminate the guess work whenever it was necessary for a district ranger to decide if ground and initial attack forces and lookouts were needed on the off-duty days. The use of the manning guide has eliminated the payment of overtime during those periods when the fire danger did not warrant using overtime.

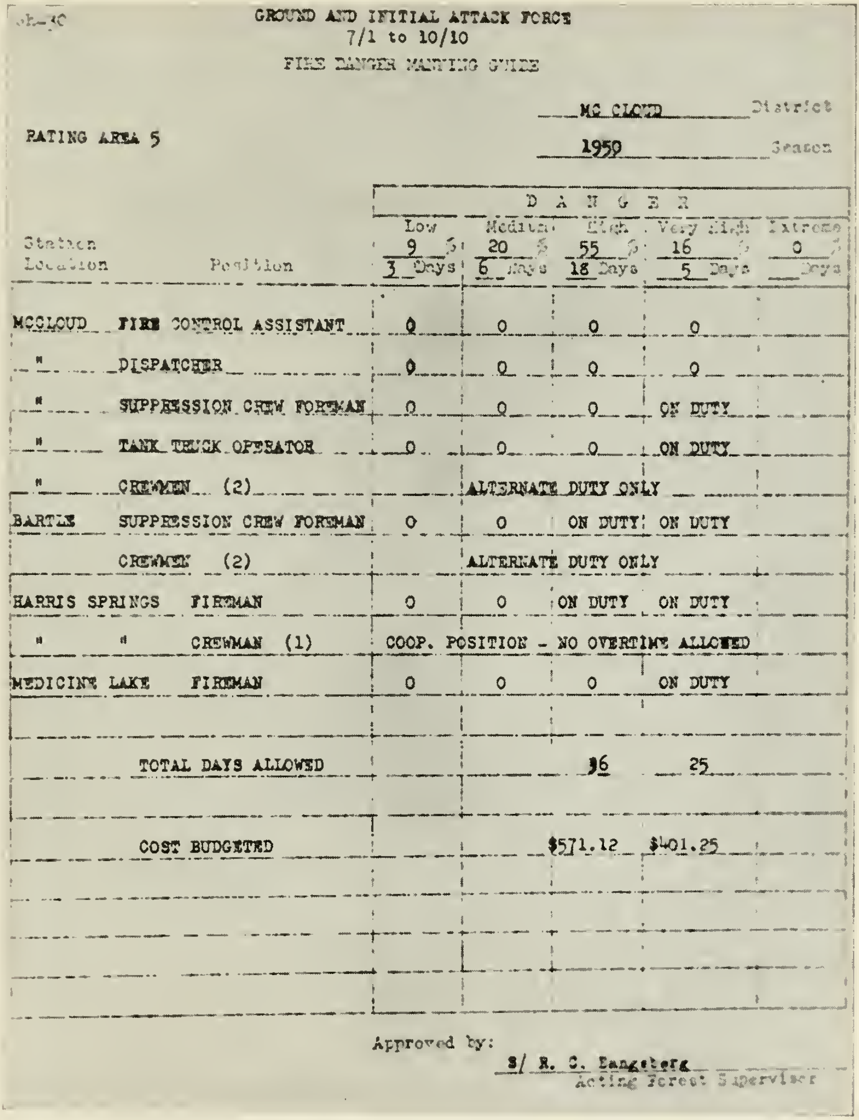
The manning guide was designed to cover only the man-caused risk and occurrence. During periods of lightning storms or storm predictions, heavy drains on district forces for off-district or forest fires, continual long periods of high or very high danger, or unusual high use, it is necessary for the district office to explain to the supervisor's office the conditions which warrant consideration. The supervisor's office approves all justifiable requests to meet the unforeseen conditions, or obtains approval from Regional Fire Control. During the normal run of the season the district ranger, who has an approved copy of the manning guide, has the authority to hold on duty and work those positions called for by the danger rating.

The manning guide is mimeographed on letter-size sheets (fig. 1). The heading is in three parts: Station location, position, and danger. The first two are self explanatory. The third, danger, is broken into the five classes of danger used in Region 5: Low, medium, high, very high, and extreme. Under each danger class are two blank spaces, one for percent of the season total in that class, and the other the number of off-duty days expected to fall into each danger class.

As this system has not been used for a long enough period to determine a yearly average, it has been necessary to use the preceding year's fire-danger rating to arrive at the percent of time for each class of danger. To arrive at these figures for ground and initial attack forces for the period of July 1 to October 10, we take from the fire-danger rating form for each district the total number of days for each danger class and convert it to percent.

The next step is to determine the total number of off-duty days between July 1 and October 10. This is then broken into the number of days that can be expected in each danger class by using the appropriate percent.

The next step, after arriving at the percent of time and number of days, is to list the location of each station and the position or positions at each location for each ranger district. After these entries are made, we determine when each position is authorized to go on duty, on the off-duty days. No authorization for overtime is allowed for low or medium days as our regular force should and must be able to cope with any man-caused fires during these two classes of danger.



GROUND AND INITIAL ATTACK FORCE
7/1 to 10/10
FIRE DANGER MANNING GUIDE

MC CLOUD District
RATING AREA 5
1959 Season

| | | DANGER | | | | |
|---|---|---|---|---|---|---|
| Station Location | Position | Low<br>9 %<br>3 Days | Medium<br>20 %<br>6 Days | High<br>55 %<br>18 Days | Very High<br>16 %<br>5 Days | Extreme<br>0 %<br>Days |
| MCCLOUD | FIRE CONTROL ASSISTANT | 0 | 0 | 0 | 0 | |
| " | DISPATCHER | 0 | 0 | 0 | 0 | |
| " | SUPPRESSION CREW FOREMAN | 0 | 0 | 0 | ON DUTY | |
| " | TANK TRUCK OPERATOR | 0 | 0 | 0 | ON DUTY | |
| " | CREWMEN (2) | | ALTERNATE DUTY ONLY | | | |
| BARTLE | SUPPRESSION CREW FOREMAN | 0 | 0 | ON DUTY | ON DUTY | |
| | CREWMEN (2) | | ALTERNATE DUTY ONLY | | | |
| HARRIS SPRINGS | FIREMAN | 0 | 0 | ON DUTY | ON DUTY | |
| " " | CREWMAN (1) | COOP. POSITION - NO OVERTIME ALLOWED | | | | |
| MEDICINE LAKE | FIREMAN | 0 | 0 | 0 | ON DUTY | |
| | TOTAL DAYS ALLOWED | | | 36 | 25 | |
| | COST BUDGETED | | | $571.12 | $401.25 | |

Approved by:
S/ R. C. Langsberg
Acting Forest Supervisor

FIGURE 1.—Manning guide as used for ground and initial attack forces.

To determine what positions are to be on duty on the high days, we first look at the station location. If there is more than one fireman or a crew foreman and a small crew at a given location, no overtime is allowed for a high day, i.e., at a headquarters location there is usually a fire control assistant, dispatcher, suppression crew foreman, tank truck operator, and one or two crewmen. With this manpower available it is necessary for the district to set up tours of duty, by alternating the off-duty days for positions, so that 7-day regular time coverage is given.

At locations where there is only a foreman and a small crew or where there is a single fireman, overtime is allowed on high danger days. This is necessary to allow for full coverage during high days. If the position is in the high country, or so-called low risk areas, no overtime is allowed on high days.

On very high danger days, we begin to bring our maximum striking force into action. We have reached the point where it is necessary to hit and control a fire in the shortest time possible or have a large fire to fight. At district headquarters the foreman and tank truck operator are authorized to go on duty in this danger class. All single position or small crew stations are activated.

If any days fall into the extreme danger class, all of the striking force is placed on duty. All cooperators are contacted and every means is taken to prevent fire. If a fire should start on an extreme day, we have the total district force ready to roll, plus the power of rapid reinforcement to back up the initial attack force.

The final step is to arrive at the cost of financing this plan. We determine the daily overtime rate for each position, multiply this by the number of days allowed, and come out with the final cost for budgeting purposes.

The only positions that are part of the striking force but are not authorized for lieu day duty are the crewmen. Each district alternates the crewmen's tours of duty so that the maximum possible number are on duty each day of the week. Whenever the danger goes into a prolonged very high period and during extreme days, the Forest fire control officer takes a critical look at the entire Forest resources to determine if it is necessary to place crewmen on duty during the off-duty days. If conditions warrant such a move, approval is requested from Regional Fire Control, with emergency FFF financing such a move.

When a position is placed on duty, because of the danger conditions, the incumbent does not sit at his station and wait for a fire. He is instructed, by his district office, to perform certain duties such as roving patrol, contacts with recreationists, mills, logging operations, railroad officials, and employers, or working on presuppression or project jobs. The only time that a person may be held at his station is during the extreme danger, and then only the suppression crews, dispatchers, and stand-by fire cat operators are so held. The rest of the force is assigned to prevention work.

Although it takes time to figure the determining factors, the end result is that the district office has a readily available form which can be consulted daily to determine what organization is needed to cover the predicted danger for the next day.

The manning guide form is also used to set up the required number of positions needed to furnish detection for 7 days each week. The percentage factor for each class of danger from the opening date of the detection season, usually June 1, to October 10 is calculated. We again determine the number of off-duty days during the detection season and apply the percentage factor in order to set up the number of off-duty days that can be expected for each class of danger.

The difference between ground force and detection is that we need 7-day coverage by lookout. This in turn means that lookouts or alternates are on duty during all classes of danger.

We use the same method for detection as we do for ground forces to arrive at our cost figure for budgeting purposes.

It is said that necessity is the mother of invention. This is very true in the Forest Service. We feel that the Danger Manning Guide is one answer to the policy of maximum reduction of overtime expenditure. The guide has done away with the former hit or miss method of determining initial attack force needs and manning. It brings about equality of emergency manning among the districts and does away with one being manned Low while one is manned High for a corresponding danger.

## Published Material of Interest to Fire Control Men

*Are You Burning Dollar Bills?,* by P. W. Schoen. Prog. Farmer. Feb. 1951.
*A Story of Radio and Forest Fires,* by A. B. Meyer. Mo. Conserv. Jan. 1951.
*A Way to Prevent Woods Fires; Costs So Little Yet Saves So Much,* by L. T. Nieland. Fla. Grower. Feb. 1951.
*Observed Effects of Prescribed Burning on Perennial Grasses in the Ponderosa Pine Forests,* by Harold Weaver. Jour. Forestry. April 1951.
*Fire As An Ecological Factor in the Southwestern Ponderosa Pine Forests,* by Harold Weaver. Jour. Forestry. Feb. 1951.
*Fire Control at Northwest Bay,* by H. Weatherby, Brit. Columbia Lumberman. Jan. 1951.
*Fire Effects of Bombing Attack.* 45 pp., illus. Published by Civil Defense Liaison Office, Gov. Print. Off.
*Fire Protection on Your Outfit,* by H. Weatherby, Brit. Columbia Lumberman. Dec. 1950.
*Fire, Site and Longleaf Height Growth,* by David Bruce. Jour. Forestry. Jan. 1951.
*Forest Fire Smoke of September* 1950, by Howard W. Lull. Jour. Forestry. April 1951.
*Forest Protection,* by H. T. Gisborne. *In Fifty Years of Forestry in the U. S. A.* Published by Soc. Amer. Foresters.
*Honeymoon Lookout,* by Helen McDonald Clark. Amer. Forests. April 1951.
*More About Pines and Fire,* by H. H. Chapman. Jour. Forestry. April 1951.
*Northeastern Logger's Handbook,* by Fred C. Simmons. U. S. Dept. Agr. Hdbk. 6. 1951. Chapters on small tools, power cutting tools, and tractor use.
*Remember the Ember.* Amer. Forests. April 1951.
*Slash Problems in British Columbia,* by R. G. McKee. Brit. Columbia Lumberman. Jan. 1951.
*Slip-On Tanker—One Half to One Ton.* A proposed standard. U. S. Forest Service. [Processed.] 1951.
*Smokey is Convincing a Nation: Only You Can Prevent Forest Fires,* by Clint Davis. Amer. Forests. April 1951.
*Teamwork in State Forestry* (*Fire Prevention in Georgia*), by C. Elliot. Amer. Forests. July 1950.
*Twenty Years Without Fire Protection*, by K. B. Pomeroy. Forest Farmer. Dec. 1950.

# COOPERATORS' FIRE FINDERS

M. C. Howard
*Forest Supervisor, Ouachita National Forest*

Cooperators' fire finders can supplement a lookout tower detection system or may even replace it. Strategically located to take advantage of good views, telephone service, and cooperative residents, finders are readily manned for fire detection (fig. 1). Properly oriented fire finders, accurately spotted on fire control maps, make accurate fire locations possible without intimate knowledge of the territory or of local landmarks.

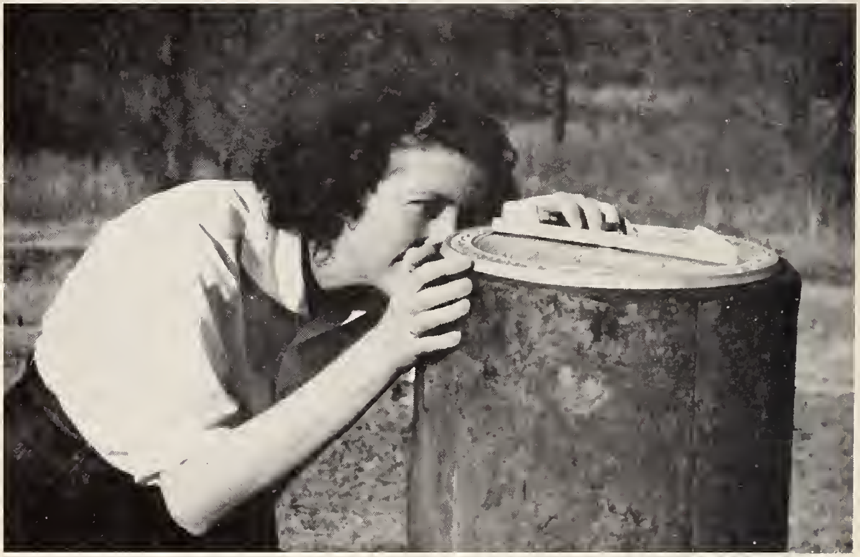
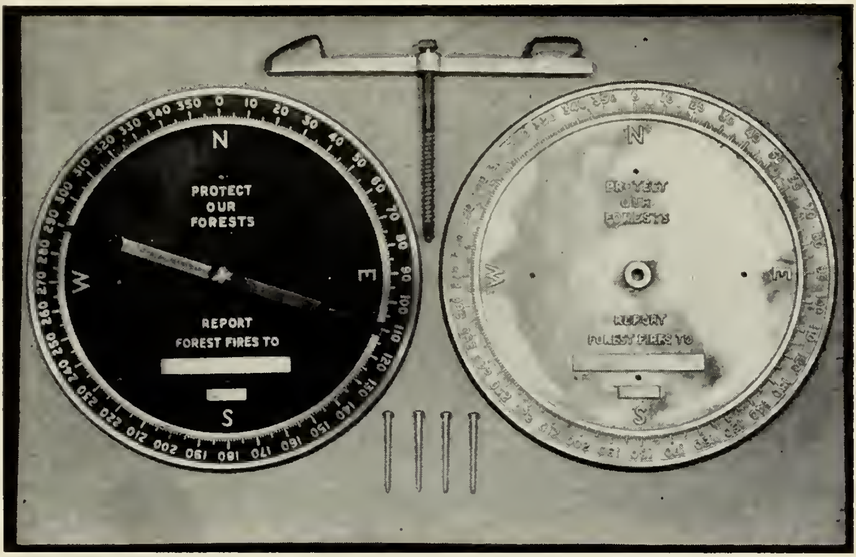


Figure 1.—A cooperator taking a bearing.

The cooperator's or warden's fire finder was a $200 project of the 1939 Fire Control Equipment Conference and was assigned to the author, then in Region 7. The pattern and first fire finders were cast in brass by an Indiana firm. The first supply cost $8.15 each and the George Washington National Forest was the distribution and purchasing agent. When the price of brass tripled, arrangements were made with an Arkansas brass works to cast some in aluminum at about the original price (fig. 2). These critical metals have made production difficult and makeshift devices may have to be used for the present. The pattern remains in the custody of the George Washington National Forest.

The Fire Control Equipment Committee in approving the fire finder project made this requirement: "To be attractive, with special emphasis



F-464375

FIGURE 2.—Assembled brass and unassembled aluminum fire finders.

on educational and prevention value." These fire finders are just that when installed at a service station or at a recreation resort. A weatherproof chart identifying prominent landmarks by azimuth reading enhances the value and utility of such an installation.

## Discarded Water Tank Converted Into Substantial 50-Foot Fire Tower

We are pleased with the results of our efforts to construct a much needed fire tower out of what was destined to become scrap iron. When we learned that an abandoned water tank on one of our State parks was to be torn down and sold for scrap we immediately made arrangements to obtain the materials by agreeing to dismantle and remove the tank. This initial step was accomplished in short order by two of our fire crews. All of the steel work and most of the cypress tank was salvaged in good condition and later used in tower construction.

The reassembly was relatively simple. Concrete footings were poured to the same dimensions as on the original tank. By marking the steel work as it was dismantled we were able to reassemble the structure without too much difficulty. From here we were on our own in substituting a cab for the original cypress tank that sat on the steelwork. This was finally worked by bolting heavy oak floor joists to the support legs and constructing a conventional size wooden cab on this base. Some of the salvaged cypress lumber from the tank was used here for framing and subflooring. The cab is boxed and sealed inside with center-matched pine flooring. The roof is of composition shingles and the windows are standard industrial steel casements. The stairways and landings are of 2-inch oak and the handrails are 1-inch galvanized iron pipe.

The cost of materials for this construction was approximately $250. This included boxing, flooring, roofing, windows, stairways, handrails, cement and paint. All labor was by regular fire crew personnel.—EARL M. BRADEN, *District Forester, Tennessee Division of Forestry.*

# SAFETY ON THE FIRE LINE

C. D. Blake

*Safety Officer, Northern Region, U. S. Forest Service*

When I look back over my 35 years of experience in fighting forest fires in the Northern Rocky Mountains, I think of the many improvements which have been made in safety practices. Early-day fire fighting used to be considered a "he-man job" where nothing much could be done to prevent injuries or fatalities to fire fighters. Many times it was necessary for the overhead and fire fighters to tough it out for weeks and some times for months, under gruelling conditions without relief or replacements.

Fire fighting is still a "he-man job." But fortunately for the present-day and future forester, specially designed equipment, rapid transportation facilities (including aerial services), better organizations and dispatching, and improved generalship training, make it practical to provide needed relief and replacement for overtaxed overhead and fire-line workers. Fire control agencies are doing a much better job of incorporating accident prevention into planning, training, supervision, and inspection.

More consideration is being given to a potential fire boss's mental, as well as physical, ability to withstand the severe strain which is invariably present when a fire is large and complex. Management has also learned that, after an extended fight to control a severe fire, there may be a letdown on the part of the fire fighters. Under such circumstances it may be advisable to provide relief or replacements for prolonged mop-up action.

Fire control agencies who adopted the "step-up," the "modified step-up," or some other modern method of organizing and controlling fire fighters, have found that much greater and safer work output is possible.

Many fire control agencies are providing for the pooling of their fire suppression resources. This is decidedly a step in the right direction. Such cooperative arrangements provide for a greater number of experienced and trained overhead personnel, who will be available to relieve shortages within hard-hit fire areas. While there has been much progress in methods that reduce injuries and fatalities on the fire line, there are still some phases of the safety job in need of improvement. I, for one, should like to see the following safety points given special consideration in future plans of operation.

1. Established medical requirements and facilities that assure periodic physical checkups of regular overhead personnel subject to call for strenuous fire duty.

2. Critical screening of fire fighters, at the time of hire, again before reaching the fire, and again at the fire line. More critical attention to suitable footwear and other clothes, and to the physical fitness of the fire fighter. (This should be particularly the case if the men are to be assigned to rough terrain, to night work, or to hot fire sectors. Most fire bosses

recognize the fact that physically unfit or improperly clothed men retards rather than increases fire-work output.)

3. Fire-line workers and overhead provided with appropriate safeguards such as suitable tools and equipment, hard hats, and first-aid facilities. Tractor operators protected by canopy guards.

4. Special project fire safety officers used much more often in dangerous areas during critical fire weather, and where 100 men or more are employed on a fire. (A fire safety officer, to serve efficiently, must be planned for, incorporated in the fire organization, and given sufficient training in advance of first assignment.)

## State Fire Control Equipment Increased

A combined inventory as of July 1950 shows a substantial increase in State-owned fire control equipment over a similar 1945 inventory. The inventory includes the 43 States engaged in the Clarke-McNary cooperative protection. In 1950 360,264,000 acres of State and privately owned forest lands were included, while in 1945 the area protected was 303,000,000 acres. A comparison of the 1945 and 1950 inventory follows:

| | | 1945 | 1950 | *Percent of change* |
|---|---|---|---|---|
| Protection roads | miles | 33,710 | 34,309 | + 1.8 |
| Metallic telephone lines | do | 22,137 | 25,041 | + 13.1 |
| Grounded telephone lines | do | 17,992 | 9,937 | — 44.8 |
| Steel and stone lookout towers | number | 1,867 | 2,301 | + 23.2 |
| Wooden lookout towers | do | 546 | 631 | + 15.5 |
| Tree lookout cabs | do | 105 | 94 | — 10.5 |
| Tanker trucks | do | 1,379 | 2,045 | + 48.3 |
| Transportation trucks | do | 1,521 | 2,468 | + 62.3 |
| Tractors | do | 486 | 935 | + 92.3 |
| Graders, bulldozers, and trailers | do | 219 | 275 | + 25.6 |
| Mechanized plows | do | 380 | 1,093 | +187.6 |
| Portable power pumps | do | 1,296 | 1,678 | + 29.5 |
| State-owned airplanes | do | 5 | 24 | +380.0 |
| Radios | do | 2,172 | 5,570 | +156.4 |

The 1950 inventory shows that 12 States operate their own aircraft; in 1945 there were 5. Other States use rented aircraft. All but 4 States now use radio. This accounts for the reduced mileage of grounded telephone line. Similarly, permanent towers are replacing temporary lookout cabs.—DIVISION OF STATE AND PRIVATE FORESTRY, *Washington Office, U. S. Forest Service.*

# DEVICE FOR TAKING WEIGHT FROM TANK TRUCK SPRINGS

DIVISION OF FIRE CONTROL
*Region 6, U. S. Forest Service*

The permanent spring sag which occurs in loaded tank trucks can be relieved by a novel and inexpensive device suggested by John C. Price, Jr., and George Norman of the Gifford Pinchot National Forest. Figures 1 and 2 give the essential details.

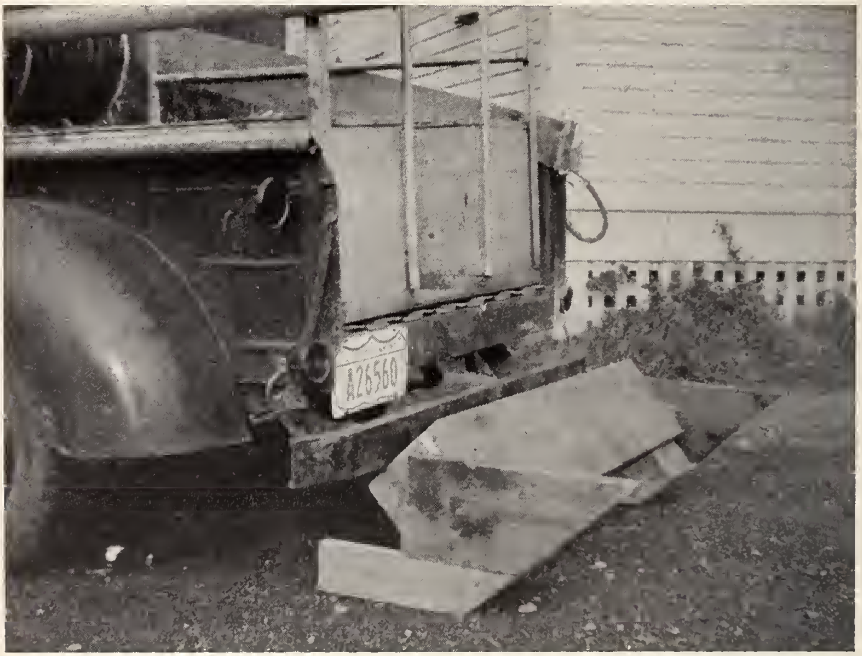


FIGURE 1.—Rear bumper in contact with blocks. At this stage an acceleration of the gasoline feed will back the truck up on the blocks.

The basic steps are:

1. Cut blocks so that when they are standing vertically they are the same length as the distance from the lower edge of the rear bumper to the ground *when the tanker is unloaded.*
2. *Fill* the tanker. Set blocks at such an angle that the top surface rests against the lower edge of the bumper.
3. Nail 2x6's in place with the blocks at this angle.
4. Join blocks at proper distance (wheel to wheel) by 2x12.
5. To prevent backing over the blocks, attach additional pieces as shown.

The device has several advantages. It takes 3 to 4 inches vertical-load pressure off the springs. No jacks or blocks are needed to accomplish this purpose, and no one needs to hold the blocks. It is portable, and

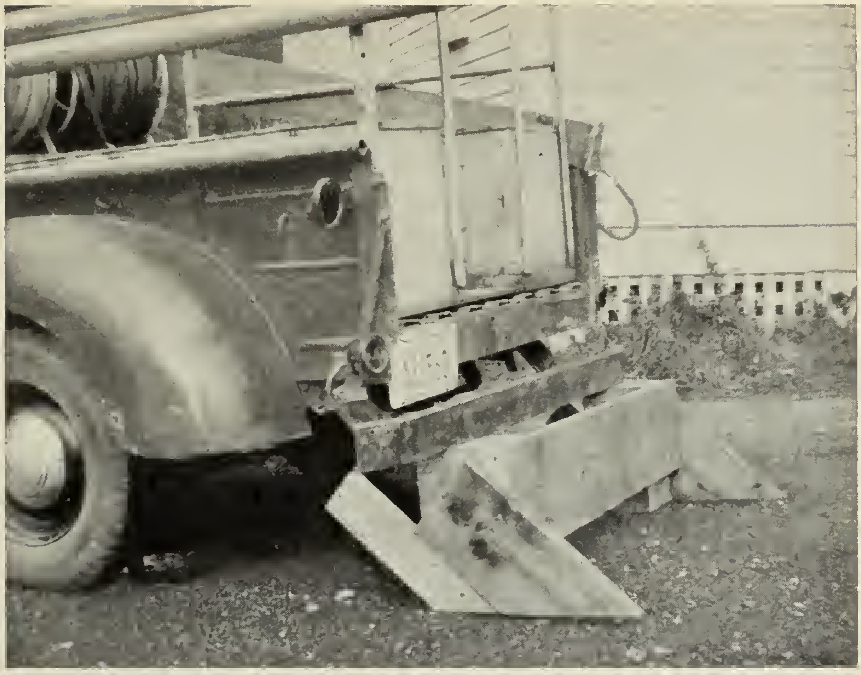


FIGURE 2.—Considerable weight is taken off the springs, tending to prevent permanent spring sag. There is still sufficient traction for the truck to be driven off the blocks.

can be used inside garages or outside in the service yard. The tank truck can be driven off the device with safety and no loss of time.

## Sleeping Bag Roller

The cleaning and rolling of sleeping bags has always presented quite a problem in central fire cache equipment warehouses. When rolled by hand the bags are especially troublesome because no two men could roll them to a uniform size. In order to overcome this difficulty a bag rolling unit was designed and put into operation in the Forest Service warehouse at Spokane, Wash., in 1944. Besides rolling the bags to a uniform size, it has proved a great timesaver. We can now store six bags where we formerly stored four loosely hand-rolled ones.

The principles of this bag roller are the same as those reported on the Coski bed roller in the July 1946 Fire Control Notes. The device consists chiefly of a shaft turned by a crank-type handle and a movable platform which holds the bags tight against the shaft by means of springs.

The roller can be operated most efficiently by two men. One man places foot of bed about crank shaft. The other stands at foot of table and keeps bed straight and taut as it is rolled. If bed has no end flaps, the straps are tied before shaft is removed.

The newer type beds with end flaps must be rolled on the machine only until the flaps reach the roller. Flaps must be left free. The crank shaft is then removed and the roll is completed by hand. The flaps are tucked over each end, the head flap completed around the roll, the bed or tie straps tightened and tied around the bed, the flaps tucked in good and snug, and the end or puckering strings tightened and tied.

Detailed plans can be secured from the Regional Forester, Missoula, Mont.—L. E. NOEL, *Procurement Officer, Region 1, U. S. Forest Service.*

# A SKYLINE FIRE EXTINGUISHER

A. B. Everts
*Equipment Engineer, Division of Fire Control, Region* 6,
*U. S. Forest Service*

The use of $CO_2$ as a pressure medium for tank trucks and back-pack units has been previously reported in Fire Control Notes from time to time.

The old soda-and-acid booster tanks, used by municipal fire departments, have been pretty much replaced with $CO_2$ or by pressure provided by pumps. Most major fire-extinguisher manufacturers now offer water-type extinguishers pressurized with a $CO_2$ cartridge. Dry chemical, perhaps the most efficient of all extinguishers for certain types of fires, and even carbon tetrachloride and chloro-bromo-methane extinguishers can be purchased with $CO_2$ cartridges. More recently, one of the large manufacturers has developed a mine-car unit similar to the skyline fire extinguisher described here, except that the extinguishing agent is Karbaloy instead of water.

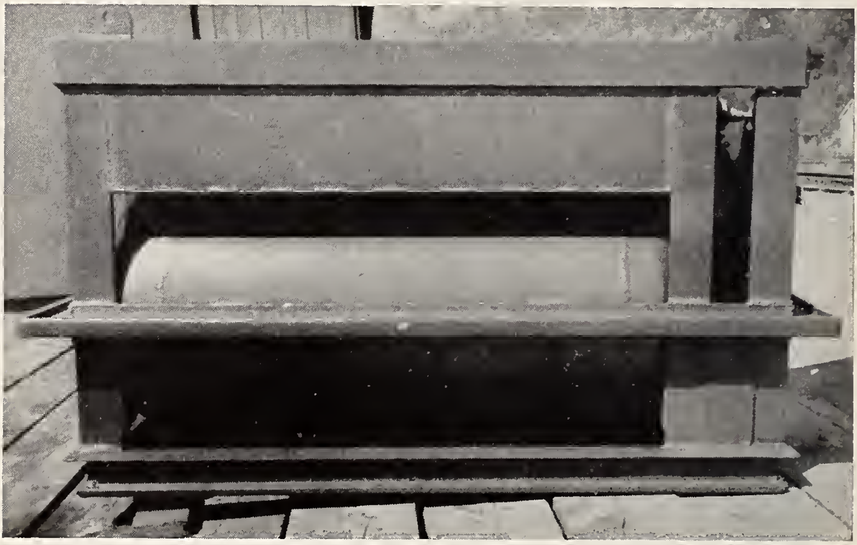


Figure 1.—Side view of the skyline fire extinguisher showing the hose and tool compartment on top. Heavily reinforced with railroad steel, it can absorb considerable abuse without damage. The tank is of 100-gallon capacity.

Two units of the skyline fire extinguisher were constructed by the White River Division of the Weyerhaeuser Timber Company of Enumclaw, Wash., several years ago. Each unit was constructed of heavy material (fig. 1). Weight was not an important factor as a skyline was used to transport the unit over the logging area. For use at log landings or as slip-on units with speeders, logging trucks, or even tractor arches, they can be of much lighter construction.

Basically, the White River unit is a 100-gallon tank pressurized with a 15-pound $CO_2$ fire extinguisher of the squeeze-grip type. The inside tube must be removed from the extinguisher, otherwise the liquid $CO_2$ will freeze the control valve. With the tube removed, the gas instead of the liquid is withdrawn to furnish pressure.

The pressure regulator, which can be set at anywhere from 100 to 150 pounds' pressure depending on the safety factor of the tank, allows constant pressure; when the nozzle is shut off and pressure in the tank builds up to that set on the regulator, the flow of gas is automatically shut off.

A safety release should also be provided for the 100-gallon pressure tank, set to "pop off" at a few pounds over that for which the regulator is set. An inside tube, extending to the bottom of the 100-gallon tank and equipped with a shut-off valve, controls the water to the hose line. A 15-pound $CO_2$ extinguisher will discharge between 175 and 225 gallons of water (fig. 2). Thus, all the liquid in the tank is forced out of the nozzle since there is sufficient excess of gas to force the water through the hose line. This is not the case when pumps are used.

In the White River unit foam is used. Six gallons of mechanical (liquid) foam is premixed with the water. A 150-gallon-per-minute foam nozzle with a shut-off is used on the end of 500 feet of 1-inch linen hose. This nozzle expends 15 gallons of water a minute, and the total 100-gallon foam-and-water premix will produce approximately 1,000 gallons of foam. In cases where linen hose has too much seepage, rubber-lined hose should be used. Two or three pulaskis and short-handled shovels are carried in the hose basket.

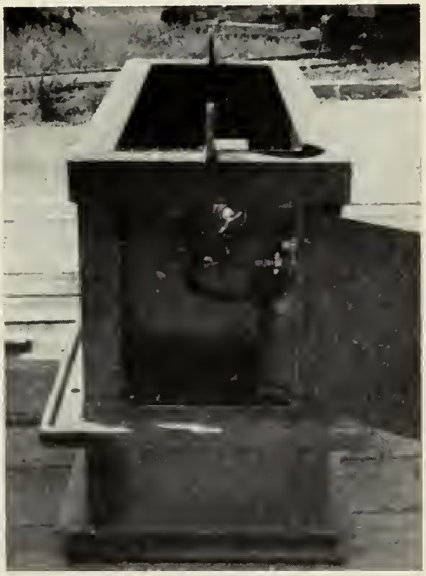


Figure 2.—End view with compartment door open. A 15-pound $CO_2$ extinguisher furnishes pressure for expelling the 100-gallon tank. Pressure is controlled and stepped down to the desired operating pressure by means of a pressure reduction valve,

Wet water, in the place of foam, will work very well in a unit of this kind. The corrosive action of wet water on containers, which some of the wetting agents are said to produce, can be neutralized by the addition of 2 ounces of commercial potassium dichromate for each 100 gallons of treated water. This was reported by Robert S. McBride, California Forest and Range Experiment Station, in the April 1950 Fire Control Notes.

One new method of using wet water, in capsule form, makes it unnecessary to premix the wet-water solution in the tank. A "hydroblender" is installed outside the tank. The hydroblender will hold two capsules, each of which will produce 1,000 gallons of wet water. The untreated water is directed through the hydroblender only when wet water is desired.

Wet water is not cheap, and this new method of mixing the solution would seem to be worth further investigation.

$CO_2$ pressured units should never be considered for replacing pumps where large volumes of water are needed. The disadvantages are obvious. However, for certain fixed or even semiportable jobs and as extra protection in risk areas, they certainly have a place.

Except for freezing, in cold climates, they can sit for months, or even years, and be ready to operate by simply cracking the $CO_2$ valve and opening the hose-line valve. Antifreeze can be used in the water if desired. There is no engine to start or to maintain. There are no moving parts except in valves and pressure regulator. Foam, wet water, or Karbaloy can be used without injury to the equipment. An excess of $CO_2$ pressure makes it possible under certain circumstances to utilize all the water in the hose. Pressure remains constant throughout the operation until $CO_2$ supply is exhausted.

## Tanker Use by the U. S. Forest Service, 1950

Tankers were used on 2,212 fires, or 22 percent of all fires controlled by the Forest Service, in 1950. The California Region led all the others by putting tankers on 973 fires. Tankers were employed in the initial stages of attack on 1,131 fires and assured control of 70 percent of these. On 646 fires tankers were sent in for mop up only. Tankers and pumpers are credited with holding 142 miles of fire line.

## Aircraft Use by the U. S. Forest Service, 1950

Some 5,636 flights totaling 8,248 hours were made by fixed-wing aircraft in 1950 on fire control work on the national forests. The 16 airplanes owned by the U. S. Forest Service made 41 percent of the flights, contract operators accounted for 58 percent, and military aircraft 1 percent. Helicopters were used in California for 1,255 hours out of a total of 1,381 hours of flight. Aircraft transported 10,244 passengers and 377 tons of supplies, of which about 174 tons were dropped by parachute. The California Region made the greatest use of aircraft during 1950 while the Northern Rocky Mountain Region ranked second.

## INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed in the manuscript immediately following the paragraph in which the illustration is first mentioned, the legend being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

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# FIRE CONTROL NOTES

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FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 12 Number 4

# FIRE CONTROL NOTES

## A Quarterly Periodical Devoted to the TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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# PLANNING HELIPORT SITES

Cal Ferris

*Chief Pilot, Region 5, U. S. Forest Service*

Contemporary forest administrators have experienced an entire decade wherein the principles, practicability, and economy of almost limitless movement over the earth's surface via helicopter have been demonstrated and developed. Therefore, the wishful thinking and general plans of the past must now be reexamined in the interests of future developments in forest transportation.

Conception of the helicopter phases for project or fire planning can be relatively simple if the proper use is made of available data. This data concerns helicopter performance and operation in combination with the established factors of load, ceiling, range, ground speeds, costs, and flight limitations.

## EQUIPMENT CHARACTERISTICS

When considering the performance of aircraft it is important to remember that the weight-sustaining capacity of air varies significantly with barometric pressure and temperature. This capacity decreases with an increase in either temperature or elevation. Therefore, the weight-sustaining capacity of the air at flight terminals is of vital importance in problems involving the landing of men and supplies. Once under way a helicopter can safely carry loads at altitudes under atmospheric density conditions in which it would be impossible to take off, hover, or land. Therefore, planners of heliports should have at hand guides for calculating these effects on standard helicopter performance. The Forest Service will include this essential information in an Aerial Operations Handbook it is preparing.

It appears now that helicopter designs suitable for use by the Forest Service will be standardized along the line of the Bell, Hiller, and Sikorski models. These models all have a single main horizontal rotor of two or three blades with a small vertical two-bladed, antitorque tail rotor. Maximum dimensions of these types are length, 40 to 60 feet; span, 30 to 50 feet; height, 8 to 12 feet; maximum gross weights, 2,500 to 6,000 pounds. The choice of landing gear installations is optional and includes skids, floats, or tricycle and quadruped wheel installations. Average pay loads vary from 400 to 1,600 pounds. Cruising ground speeds are approximately 50 miles an hour, block to block. Useful range is about 2 hours' flying time. Useable ceiling is around 9,500 feet. Operating cost runs from \$40 to \$160 an hour for integral equipment and \$60 to \$225 for contract and chartered helicopters and crews.

## PLANNING CONCEPTS

Most planned transportation systems include access roads and trails which are added primarily for fire, project, or some other one-shot purpose. Such plans should be critically examined to determine whether these roads and trails can be eliminated and aerial methods of coverage substituted. Also, a skillfully managed over-all helicopter operation would obviate the necessity for maintaining many existing roads and trails. Obviously, savings would result in both construction and maintenance costs.

It should be remembered that helicopter planning encompasses area or radial coverage in contrast to the strip type of coverage usually provided for; this may result in a certain amount of allowable overlap in controlled area.

The heliport plan should provide for three basic site classes, permanent, semipermanent, and opportune. These are summarized in the following tabulation and shown in figure 1.

| *Class* | *Development* | *Name* | *Designation* [1] | *Facilities provided* |
|---|---|---|---|---|
| I | Permanent | Base heliport | BLIP<br>(◈) | Maintenance, servicing, communications, housing, parking, air markers and navigation aids, safety devices. |
| II | Semipermanent | Satellite heliport | SHEL<br>(O) | Maintenance, servicing, communication. |
| III | Opportune | Helispot | HIPO<br>(X) | Only as needed. |

A fourth site class, undesignated emergency spots (EMOT), covers a large number of locations that are developed and used to accommodate some special demand for helicopter service. Although records of these sites should be carefully maintained, such sites need not be considered under any but the most intensive type of transportation plans.

Mapped locations (fig. 1) should be further described in accompanying notes to include essential information. An example follows:

BLIP #1 System

| *Identification* | *Location* | *Elevation* | *Description* | *Remarks* |
|---|---|---|---|---|
| SHEL-B | Dome Rock | 4200′ | Raised rock dias at peak. Wind sock 50′ E. | 10% slope E. Critical temp. 48° F.<br>1 drum, 80 oct. |
| HIPO-3 | Blue Lake | 3750′ | Marked by buoy in S cove—40′ from beach. | Floats only 3′ water (4-2-51 F) |

Correction sheets are necessary to keep the records accurate between regular revisions.

## AREA PLANNING

For the present, helicopter facilities should be planned primarily for all areas below 7,000 feet elevation which are inadequately served by other existing or planned transportation. Those areas deemed especially suitable for development should be outlined on a standard scale topo-

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[1] The system of phonetic identification serves to minimize confusion in identifying specific locations. For example, "As soon as the dozers are finished at SHEL-Dog, send one to help the crew on the job at Charlie-HIPO-five."

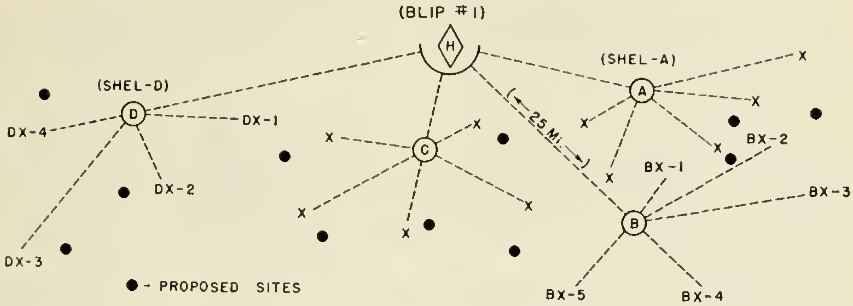

FIGURE 1.—Schematic diagram of proposed sites in a heliport plan. Blip (◆), permanent base heliport; Shel (O), semipermanent satellite heliport; Hipo (X), opportune helispot. (Phonetic identification clockwise.)

graphic map. In this planning, ground control areas should be examined for the possible elimination of nonessential roads and trails. Only very special sites, such as airports or flight strips, large lakes, or meadows should be considered for elevations above 7,000 feet.

Altitude zoning can be accomplished through the simple expedient of coloring all areas red on the base map above 7,000 feet and hence unsuitable. The zone between 4,500 and 7,000 feet, which is considered suitable for marginal or reduced services, can be cross-hatched or a cautionary color, such as yellow, used.

Another very essential part of the base map is the precise location of air hazards such as power and telephone lines, spans, and trestles, and known ground hazards, such as fences, wet or gullied meadows, hidden slash, stumps or rock outcrops, crusted areas, and submerged hazards.

Designated heliport sites can be indicated on the base map, but are preferably shown on a transparent overlay that permits easier revision, reproduction, and interpretation.

The over-all spacing of site locations varies according to individual situations, and is discussed later in detail.

Consideration of site suitability with regard to accessibility should be considered next by the planners. This entails a careful study of factors such as adjacent obstructions, wind currents and other hazards, and site surfaces; and evaluation of use patterns including concentration of users, available transportation facilities, such as roads, trails, airports, waterways and lakes, and values to be protected or managed.

## GENERAL CONSIDERATIONS FOR SITE LOCATION

If possible, place the heliports above the areas they will serve and where they can be quickly and easily reached by complementary ground travel. Because a very real hazard to personnel is always present in the moving rotors, every possible precaution must be taken to minimize this potential danger. This includes placing marshalling areas for any significant assemblage of personnel, stock, or equipment at least one-tenth of a mile away from the spot; providing for ground access routes well below the plane of all rotors and from directions easily visible from the control station in the machines; safeguarding against injuries to eyes and lungs, which can be caused by dust blown from untreated surfaces by rotor blasts. Operating areas should be fireproofed to protect valuable equipment, and in addition, portable extinguishers should be provided to the necessary servicing facilities.

It has been suggested that three categories be established for determining the priority of heliport development, viz., (1) earliest possible, (2) probable future, (3) upon special demand. Where proposed sites are questionable for any reason, a general helicopter pilot or his technical equivalent should be consulted before final approval for development is granted.

## PERMANENT AND SEMIPERMANENT HELIPORT STANDARDS

In selecting a heliport site, consideration should be given to (1) the type of service expected; (2) number and kinds of helicopters anticipated; (3) clear channels of approach; (4) surrounding obstructions and their effect on air currents; (5) surface conditions.

With present equipment, a heliport should have approaches to permit landings and take-offs at angles from the outer limits of the touch-down pad of 10:1 into the prevailing wind directions and 5:1 in other directions. These minimum angles will permit safe and economical operations under all conditions.

The touch-down pad should have a minimum diameter of 50 feet where not more than one helicopter is to land at a time. The safety area that surrounds the pad will vary depending upon obstructions and dust conditions. This area should extend a minimum of 50 feet from the outer edge of the touch-down pad, be restricted by a low barrier, and it should be dust and fire proofed. Above 6,000 feet this site must have a very smooth, extended surface to facilitate running take-off techniques. The sharpest possible contrast between the pad and the safety zone should be obtained for easy air identification under all conditions. When this is not feasible, the heliport may be marked by a circle with an "H" in the center. Where night operations are anticipated, a distinctive flashing beacon, boundary, wind indicator, and obstruction lights should be provided.

Roof, platform, or other structural heliports must be stressed to withstand impact load strains equivalent to ¾ × the gross weight of the helicopter on any one square foot of surface, in addition to existing dead loads.

Easily visible wind-direction and velocity indicators, either small socks or flags, should be provided for all heliports.

A diagram for heliport site improvement is shown in figure 2. The requirements illustrated are for normal conditions. Allowances to compensate for any variance will be necessary.

## TEMPORARY LOCATIONS AND STANDARDS

Helispots are ordinarily located at opportune sites that require a minimum of improvement for their occasional use. These spots should be prospected and charted in anticipation of convenient development. No maintenance is normally contemplated. When one is improved, the records of its characteristics and use should be kept for future reference.

Open ridges with opportunity for horizontal or descending take-off in either of two prevailing wind directions represent suitable sites. These sites

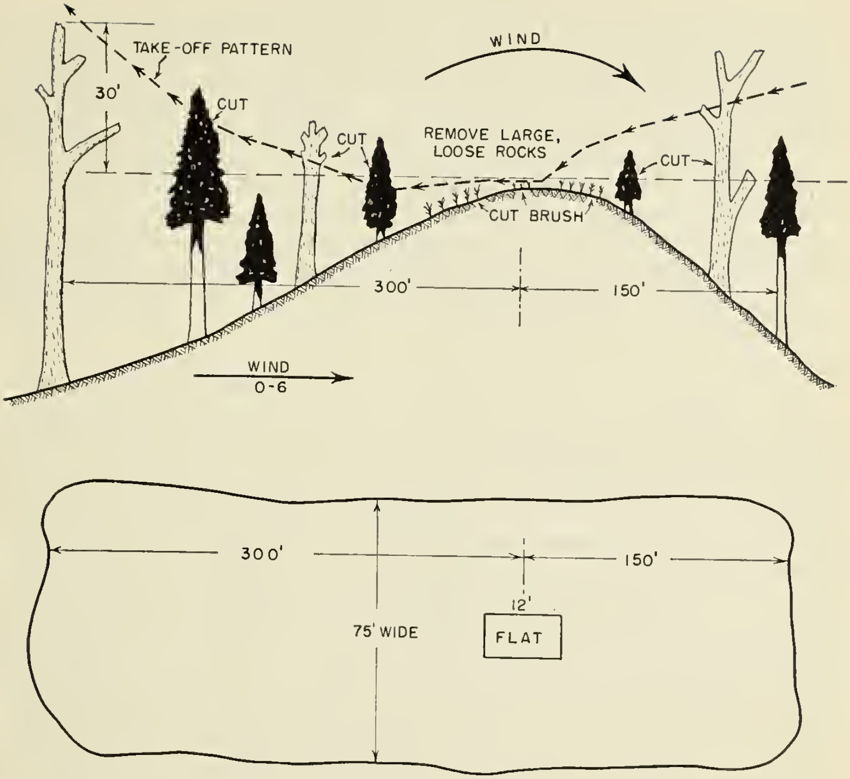

Figure 2.—Heliport site improvement plan.

must be free of brush, trees, or other obstructions protruding above the level of the touch-down pad.

On sharp ridge tops below 6,000 feet where brush and trees are not a problem, a nearly level spot surface about 10 by 15 feet is normally adequate for one-ship operation. On areas where low brush or trees are not more than 10 feet tall, the cleared landing spot below 4,500 feet should be at least 60 feet in diameter. Where obstructions or elevations are higher, the diameter of the cleared area must be increased to conform with the appropriate translational lift and rate of climb tables.

No landing spot should be considered in the plan that has more than 10-percent surface slope. Emergency landings can be made on steeper slopes, but such slopes are in the "critical landing" class and have no place in a preplanned system.

A smooth, flat surface is not essential to a landing spot if the pilot is fully aware of what he is settling down on. Emergency operations are frequently conducted from boulder strewn, gravel washes and sand bars. The key is to insure that no rocks or stumps stand high enough to touch the supporting structures of the alighting gear. Special care should be taken to guard against soft or crusty spots in the touch-down surfaces. Brush stubs and rock piles must be leveled to reduce skid rocking, tire and float puncture, or snagging of occupants.

If a landing spot is on a sharp knob or a ridge, the ground effect will be lost very soon after take-off. In all probability this will occur while the helicopter is undergoing the critical transition between hovering flight on a column of compressed air and translational flight which derives lift from relative motion through the air. To compensate for this, the area in front of the landing spot should be cleared a bit lower than the site level for at least 100 feet from pad boundaries along the departure routes.

Brush, tall grass, or other protruding obstructions must be cleared out from approach zones so that the tail rotor (clearance less than 3½ feet) will not hit anything during the flare-out for landing. Care should also be exercised to avoid pockets, saddles, bluffs, and other spots which are normally subject to unforecastable bad air currents.

## PLANNING THE LOCATION OF LANDING SPOTS

Planning for the spacing of site locations consists largely of applying old, established principles and logic in such a way as to exploit the unique advantages of the helicopter. In addition to the general factors discussed earlier, there are a few basic systems used for planning heliport networks. These systems vary because they are designed to fit individual situations.

The first and most widely accepted system is employed in the California Region. This region's primary objective is to achieve hour-control over areas where existing and planned transportation facilities are deemed inadequate. The question of adequate hour-control coverage is determined by a careful study of all implications involved in the various combinations of flammability types—values that could be affected through a changeable use pattern. The risks and hazards resulting from a changeable use pattern must also be considered. This system lends itself very well to the adjustments required where lower priority control zones, i.e., lesser values and/or occurrence, are encountered. Theoretically, in areas where characteristics are uniform, this system results in locating heliports in places equivalent to approximately twice their allowable attack radius.

Similarly, some other controlling factor in heliport placement, such as normal rates of spread, will serve. When the least favorable circumstances are selected as a controlling factor, the number of bases should be held to a minimum by strategic adjustments suited to the various flammability zones. As an example of this system, in a 30-minute zone, the bases might be spaced about 40 to 50 miles (1 hour) apart. This would mean that even peripheral deliveries from adjacent bases to spots nearest a fire could be accomplished in 20 minutes and so allow sufficient time for ground travel. Where innumerable chances exist for the use of smoke-hopping techniques, the location of bases at radial extremities near 25 miles might be possible.

Secondary satellite bases can be spaced inversely proportional to rates of spread. This will result in a greater number of bases in brush than in timbered country. Cover types, topography, values, benefits, and costs are given increasing weights in considering these developments. Such landing spots should be planned so that they are strategically interspersed and complement the more permanent facilities. Frequently these spots are located only to accommodate some specialized function, such as critical points along a fire line, rescues and evacuation of personnel, or as the result of emergency landings.

Another basic system for planning and selecting heliport locations is becoming increasingly popular and successful in highly developed parts of the western regions. This system is planned by geographical drainage or value units, and is especially applicable to areas where moderately intensive transport, management, and protection already exist. It employs the same fundamental plans of location and construction already discussed.

Intimate field knowledge of all the aspects of the terrain involved, along with the real nature and value of the associated resources, is prerequisite for selecting this system. When considered for, or applied to, relatively undeveloped areas, the additional planning investigations necessary to assemble the required data are expensive, time consuming, and often prohibitive.

Such a system frequently requires greater liaison between districts and forests to provide for joint controls and development of boundary areas. In aerial operations, the importance of artificial boundaries is secondary. In other words, under this drainage system, don't terminate plans along a stream that separates two units when desirable landing spots are available on the other side.

An additional factor in strategic placement under this system is to locate Class I and II heliports at easily accessible spots along the major divides. This will make it possible for the helicopters to drop off into the various areas with the least delay and greatest ease.

For areas that approach the ultimate intensity of planned coverage, special heliport systems can be devised wherein the fullest possible use is made of pertinent data already assembled. Examples of this type of planning may be found in areas undergoing development similar to the upstream flood control established for the Los Angeles River drainages. This project combined the acme of present planning concepts, based on intensive evaluation studies, with an intimate knowledge of fire occurrence and behavior.

As a result of the careful correlation of all factors, both real and implied, local fire protection authorities were able to complete their collective protection strategy and actually pre-locate fire lines which are now being developed as fast as possible. Helispots are located wherever necessary to fill in transportation time gaps and provide economical services. Such planning has made possible the simultaneous construction of improved helispot facilities at frequent intervals along actual fire lines which, fortunately for this purpose, follow the ridges in flash-fuel cover types. Since both the crews and equipment are "on location" for this special type of associated construction, helispot construction and improvement costs are advantageously reduced to an absolute minimum. As an example, Angeles National Forest reports average helispot construction costs in medium brush at $12 for hand labor and $9 for tractor. A complete discussion of the development of this system appeared in FIRE CONTROL NOTES, April 1951.

In addition to the essential preparations of basic data already described, the following actions should be employed wherever necessary to insure the easiest evolution of the complete plan.

1. Make a vellum overlay for each sheet of the planned road system status map, with match marks and other data necessary for its accurate use over the base maps.
2. Consider the possible elimination of questionable corollary projects at this stage, and include any actions shown in the current record correction notes.

3. Show on the transparent overlay new roads, airstrips, artificial lakes, or any other especially suitable facilities not included on the base maps, excluding field headquarters, commercial heliports, military installations, etc.

4. Show on the overlay locations temporarily selected as suitable. These selections can be based on personal knowledge and consultation, careful study of topographic maps, or interpretation of aerial photographs.

5. Shift proposed locations to improve the pattern. The center of a movable transparent disk, with the radius determined by control factors, can be shifted among the proposed site locations for a rough illustration of theoretical time-zone coverage limits.

6. Reexamine the preliminary proposals, fill in the gaps, reduce congestion and overlap. An acceptable academic coverage pattern should result.

7. Number 6 is an office phase of the planning and must be substantiated by objective field investigations of proposed sites. To accomplish the job of field checking all proposed sites solely by ground reconnaissance is impractical. A combined air-ground check will cover hundreds of sites in a short time, and information obtained by reliable air observers will be accurate enough to pin point most of the suitable spots and coordinate the proper interim development of other facilities. Checkers should be especially alert for unfavorable flying conditions such as down drafts, obstructions, and congested areas. Avoid spots that would involve difficult engineering projects, such as rock outcrops, and marshes, whenever possible.

8. As a result of the above actions, select, within allowable economic limits, the locations that are best suited to the standard of development proposed. Eliminate the unsuitable ones and readjust the pattern to fill any gaps.

9. Educate field personnel in the intricacies of recognizing low-standard sities and alert them to the necessity for studying their local areas for sites requiring minimum development. They should also be taught to note possible locations and forward pertinent records to the appropriate engineer.

As the heliports are developed or altered, they should be classified and identified for reliable reference; accurate maps of the locations and historical records of their prior uses should also be maintained. This is essential information for the local engineers and air officers. It may be desirable in some locales to planimeter the helicopter zones and determine such factors as the facility-square mile ratios, by zones, etc.

### Improving Teamwork on Interagency Forest Fires

The suppression of many forest and range fires requires joint action by personnel of two or more protection agencies. To be most effective good teamwork and mutual understanding must be developed in advance. The usual formal written cooperative fire control agreements between agencies should be supplemented by local working arrangements. It is important that variations in policies, procedure, organization, and terminology be understood and reconciled in advance if delays and misunderstandings are to be avoided.

In order to study these problems and attempt to improve future joint suppression action, a very successful meeting was held in Yosemite National Park on April 19 and 20, 1951, attended by more than 60 Forest Service, National Park Service, and California State Division of Forestry officers. These men represented the Regional Offices and State Forester's Office, 3 National Forests, 4 National Park areas and 5 counties.

Each agency analyzed its fire and administrative organizational setup, procedures, fire overhead job descriptions, and terminology. Minor variations were noted but no serious obstacles to joint action were apparent so long as these differences were known in advance. Following this discussion the group divided into 4 teams, each composed of representatives from the several units of the three agencies. A sample large fire problem was worked out for manning, tactics, strategy, and supply. Each team solved the problem independently and, when later compared, all solutions were similar despite the diversity of organization and variation in general agency objectives and programs. In fire control all strive for the same result—reduction of losses.

Selection and designation of overhead positions on joint action fires was discussed in some detail. The accepted rule that one man must be given total command as fire boss on every fire was recognized. It was also agreed that the best man, regardless of official title or agency, should be selected and that this is the responsibility of top local administrators who should have an advance understanding in this regard. After a fire boss is designated it is his responsibility to make systematic division of work on the fire to utilize all men and facilities of all agencies to best advantage. Individual and agency responsibilities and their tie-in to the over-all plan must be clearly defined. A fluid and dynamic organization must be established and maintained. Many of these matters can be prepared for in advance by mutual discussions such as this meeting provided.

Perhaps the most difficult problem of fire suppression involving overhead from more than one agency is that the men may not know each other well. A fire boss must have confidence in his key assistants and they in turn must rely on his competence and judgment. Without this mutual reliance weaknesses develop in management of the fire. If no other value had been derived from this meeting of the three agencies, the fact that each man became acquainted with the others made the meeting worth while. Official titles and other formalities were promptly forgotten. From this acquaintance mutual confidence and understanding should be immeasurably increased.

The group recommended the holding of similar meetings annually. Others might benefit from this type of get-together.—L. F. Cook, *Assistant Chief Forester, National Park Service.*

# FIRE PREVENTION NOTICES IN VIRGINIA

George Dean

*State Forester, Virginia Forest Service*

The posting of fire prevention notices along the highways has long been a standard public relations technique here in Virginia. During World War II a few roadside billboards were carrying forest fire prevention messages, but it was not until 1947 that more intense efforts of this kind were directed at the motoring public (fig. 1).

Metal highway signs, of which there are 5,600, are erected on all the primary and all paved secondary roads in the State. These signs, made of 16-gage steel, measure 24 by 30 inches, and have raised green lettering on white baked-on enamel background. The signs were made by the metal shop of the State penitentiary at an approximate cost to the Virginia Forest Service of $2.30 each. The signs are mounted on 4x4-inch pine posts ob-

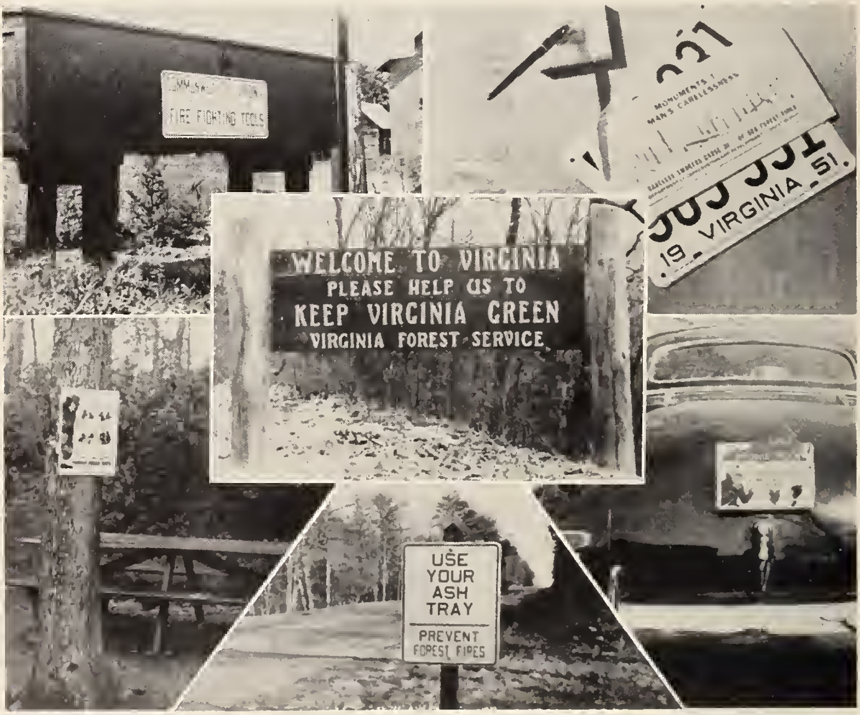

Figure 1.—Fire prevention notices in use in Virginia.

tained from and creosoted at the Buckingham State Forest. The coverage obtained from 5,600 signs is approximately 1 sign every 7 miles.

The next move to attract the attention of the motoring public was to make a unit of the fire warden tool box and warden flag and locate them conspicuously along the highway. A large metal sign, stating the fire fighting tools in the box are for use on forest fires, is mounted on the front of the tool box facing the highway. The warden's name is lettered on a paddle which is hung under the warden flag. This complete warden unit naturally causes local comment and also augments State-wide forest protection publicity.

All Virginia car owners are required to purchase license plates annually. Inserted between the new license plates he now finds a reminder on forest fire prevention. The appeal usually is directed to the use of the ash tray in the vehicle. This license stuffer reaches approximately 800,000 vehicle owners each year.

The Virginia Department of Highways has been developing picnic areas along all the major highways. There are now 1,243 such sites. At each of these areas the Virginia Forest Service has erected a poster board, made of wood, on which an outdoor fire prevention poster is tacked.

There are also, especially in the mountain section, developed vistas. Here, too, posting boards are erected. Truck pull-offs, usually at the top of a long grade, are excellent spots for these poster displays.

License plate attachments, made of light metal cut in the shape of the State and carrying the wording "KEEP VIRGINIA GREEN" on a forest green background, have been requested by a large number of people. Approximately 6,000 of these were given to vehicle owners by the Virginia Forest Service last year.

Large wooden, creosote-colored fire prevention signs, with routed 6-inch letters painted orange, have been erected on all the main highways leading into the State. These signs are very rustic in appearance, measure 8 by 3 feet, and are hung with large logging chain between 10-inch chestnut posts.

Smokers are responsible for approximately 38 percent of the forest fires in Virginia each year and it is believed that a good prevention program directed at the traveling public will probably reach most of the smokers. It is only through the splendid cooperation of the Virginia Department of Highways that this entire program has been possible.

## Protection of Fire Tool Handles

To protect handles of fire tools carried in pickups and tanker tool boxes cut lengths of old cotton fire hose 1½ by 42 inches and slip them over the handles. This practice adopted on the Happy Camp District has lessened the problem of tool maintenance.—GIDEON S. PARKER, *Modoc National Forest.*

# MACHINES AND THEORIES

Frank J. Jefferson

*Assistant Regional Forester, Region 5, U. S. Forest Service*

We have available to the field of fire control today several relatively new machines. Our constructive thinking is lagging, however, as to which of these truly offer increased strength to fire control and how they can be used most beneficially. We are inclined to accept theories as facts and, because of this, apply them in an amateurish, unresultful way. We shy from going through the hard process of working out in detail the changes in organizational practices necessary to make these new machines of fullest use, and of evaluating the cost-benefit ratio. The pitfalls inherent in such a casual method do not show up much during an "easy" fire season, but they certainly raise hob with fire control effort when the chips are down and every move must be made with dispatch and sureness. For the purpose of this discussion, let's consider four items that have been much in the limelight in recent years. There are others.

## HELICOPTER

The helicopter obviously can give all fire-fighting overhead, including fire boss, division boss, and sector boss, up-to-date information in a matter of minutes as to conditions on all parts of a fire line—even on a fire of 40-mile circumference, 40 miles in 40 minutes. A fire boss can get a quick picture of the entire situation; and remember he sees all of this himself, and can personally evaluate all observed situations as they relate to each other. Compare this with ground practices where scouts laboriously work over segments of line, send in their data by radio, telephone, or messenger. The fire boss and his assistants must then plan actions based on interpretation of information which in many cases is several hours old.

Well-coordinated use of helicopter and radio can reduce the force behind the line and improve surety and timeliness of action. The helicopter can provide quick transport of workers from one critical point to another, and the number of points where it can be landed on a fire line, if the pilot is skilled, is truly surprising. This machine can also make quick deliveries of water, tools, food, and other essential supplies to line workers by either landing or dropping, and men can be maintained close to their job if camp bases are properly selected.

To accomplish all of these things, however, in a degree that pays off in reduced cost and losses requires an operation planned and acted upon at the helicopter's speed level rather than one part at the helicopter's level and the other at truck speed. For example, last summer thirty-odd men were picked up one afternoon on a section of line, transported by helicopter several miles to a new sector, and sent into action immediately. Later in the afternoon a new camp was established by helicopter on that sector. Not until night came was it realized that the personal belongings, time slips, and other important items had not been shipped to the new base. There were two results: a near riot on the part of the crew, whose first thought was no clothes, no pay, no nothing; and poor crew work and morale the next morning. All of this resulted from an incomplete helicopter-use plan.

In planning, it must be remembered that the possibility of any sort of air operation is controlled by visibility and air condition. Smoke, fog, darkness, or excessive wind rule out the air. So whatever the plan for air use is, it must be complemented by an alternate plan based on the old reliables of transport by truck, by tractor or by mule, and as a last resort, by man back-pack, if sureness of action is to follow. But first of all, if we are going to use helicopters, we must get thinking and actual planning fully attuned to the speed with which a helicopter can act. This requires methodical planning of the ways and means of running a helicopter operation and a methodical carrying out of the plan. The plan can't be "catch as catch can"; it must be completely fitted to the machine that it uses, or it will not pay off.

## RADIO

What has been said about helicopter can well be applied to radio. This device can be one of the most helpful that we have for speeding up all phases of line action. It is a worthy complement to the helicopter, and together they can revolutionize the first suppression job. However, radio can likewise excessively complicate an undertaking by its very speed of action. The failure of a fire boss and others who give instruction by radio to promptly send instructions to *all* who are concerned with the action of an individual, or results of the action, may have serious consequences. Here again there is urgent need to figure out the essential procedures necessary to fit the speed of radio action and then sternly discipline ourselves to observe these procedures.

## TRACTORS

We must learn to use tractors as a complement to man-power and not regard them as a complete substitute therefore. Tractors can build line but have never yet clean-burned one. They never will. Probably the greatest cause of line loss today is from unclean tractor lines. A few flights over major fires should convince anyone of this. The miles of lost tractor line are appalling. Here again is a device that can be a mighty ally. Its usefulness, however, is being negated because men, fascinated by its brute strength, noise, and ability to produce wide line quickly, are disregarding the basic principle that a safe fire line is a clean-burned one.

## BOMBING PLANES AND OTHER AERIAL OPERATIONS

It is theoretically possible to put water on fires in practically unlimited quantities from the air. All that is needed is a sufficiently large fleet of planes equipped with big water bombs and a landing place with water supply close to the fire. Practicably, this means that the Nation would have to be covered by several thousand water-equipped bases, each with probably 10 large bombing planes and trained personnel available, to make the operation effective. The cost of such an undertaking would be staggering;

it would still be staggering if such operations were limited to the west coast. Therefore, this is one of the proposals that, while theoretically possible, is unsound economically.

In the author's opinion, rain-making projects are likewise economically unsound as a generally planned-for fire control measure. Granted that under proper atmospheric conditions, and with proper equipment, rain can be made. However, it just isn't ever going to be possible, at a reasonable cost, to insure having the proper equipment and materials available at the proper time and place. And no man can arrange to have the proper type of cloud on hand at the time of a fire. In this connection, it is important to realize that while a day or so's difference in time isn't too vital in the case of rain for crop production, it is a tremendously important factor in fire suppression. In that day, fire is over the ridge and far away. So again we have a theoretical possibility that in application is limited.

There is loose thinking concerning the use of planes for observation purposes. All too many believe that the availability of a plane is the key factor. This belief is definitely wrong. A plane is necessary, of course, and it must be a plane that is *safe* for the proposed operation. The controlling factors from the fire-information standpoint, however, are the availability of pilots with the skill to safely put a plane in the right place for the observer's purpose, and observers with skill in the knowledge of fire behavior and the ability to interpret and accurately record fire facts that they see on the ground. These qualifications are infrequently combined in a pilot, and all too often casually assigned observers can't interpret or correctly record what they see. The result is misinformation and erroneous-action decisions.

Our use of the plane or helicopter for observation purposes will not be most productive until we develop an adequate corps of skilled pilots and properly qualified observers for each unit of organization, i.e., forest, county, or association area. This does not at all mean pilots and observers who are regularly on a fire control agency payroll. Many private pilots and their fellow workers can be trained in this field if adequate effort is made. Identification and interpretation of fire facts is not an esoteric art.

# THE FLANNELGRAPH AS A FIRE CONTROL TRAINING AID

Robert B. Moore

*Forester, Region 4, National Park Service*

Fire control training officers search constantly for new methods or media to increase the effectiveness of fire control training. During a recent meeting devoted primarily to a review of the principles of fire management and the build-up of organization on large fires the flannelgraph proved to be an arresting and effective training aid.

The flannelgraph works on the principle that some materials have an affinity for each other. Flannel, felt, or sandpaper will stick to a background of flannel without an adhering agent even when the background is in a vertical position.

Flannelgraphs have many uses. They are at their best, however, as lecture aids, especially when used to show changes, tell progressive stories, or make comparisons.

Our flannelgraph story used the organization chart for large fire suppression from "Principles of Organizing For Forest Fire Suppression," California Region, U. S. Forest Service. Primary and subordinate functions for the respective fire positions were briefed and printed in large block letters on colored, medium-weight paper. One color was used for the top fire Management functions, another for Suppression, a third for Planning, and a fourth for Service functions. Job titles were printed on plain white paper.

Pieces of flannel were rubber-cemented on the backs of these separate "parts." A 3-foot-square piece of good grade white cotton outing flannel was used for background. The background flannel was stretched tautly and fastened securely to a smooth wall.

By adding, shifting or removing the parts as desired the training officer is able to present clearly and simply the progressive build-up of organization from a small one-man or one-crew fire to the more complex large fire organization. Uniform and clear-cut distribution of duties and definite channels of command can be emphasized graphically as the story unfolds. Functions that must be performed on every fire, regardless of its size, manpower and equipment requirements, can be effectively presented.

The flannel-backed parts sometimes require a slight hand pressure to adhere well to the background. Fine to medium grained sandpaper is said to work best of all as backing material.

The flannelgraph should be kept as simple as possible. Illustrations or lettering should be big and bold to be easily seen from a distance. Colors stand out. The flannelgraph should be well lighted. For the leader's convenience the parts should be numbered or otherwise identified or arranged for orderly use. Guide lines may be required on the background.

Admittedly we have but scratched the surface in the use and adaptability of the flannelgraph. We found it to be a most effective aid deserving of wider use in forest fire control training.

# EASELS FOR FIELD USE

J. W. Mattsson

*Forester, Fire Control, Region 4, U. S. Forest Service*

Frequently we use easels in connection with field fire training. Regular blank newsprint is the material upon which we outline training plans, summarize discussions, etc. Also in our training, including safety training,

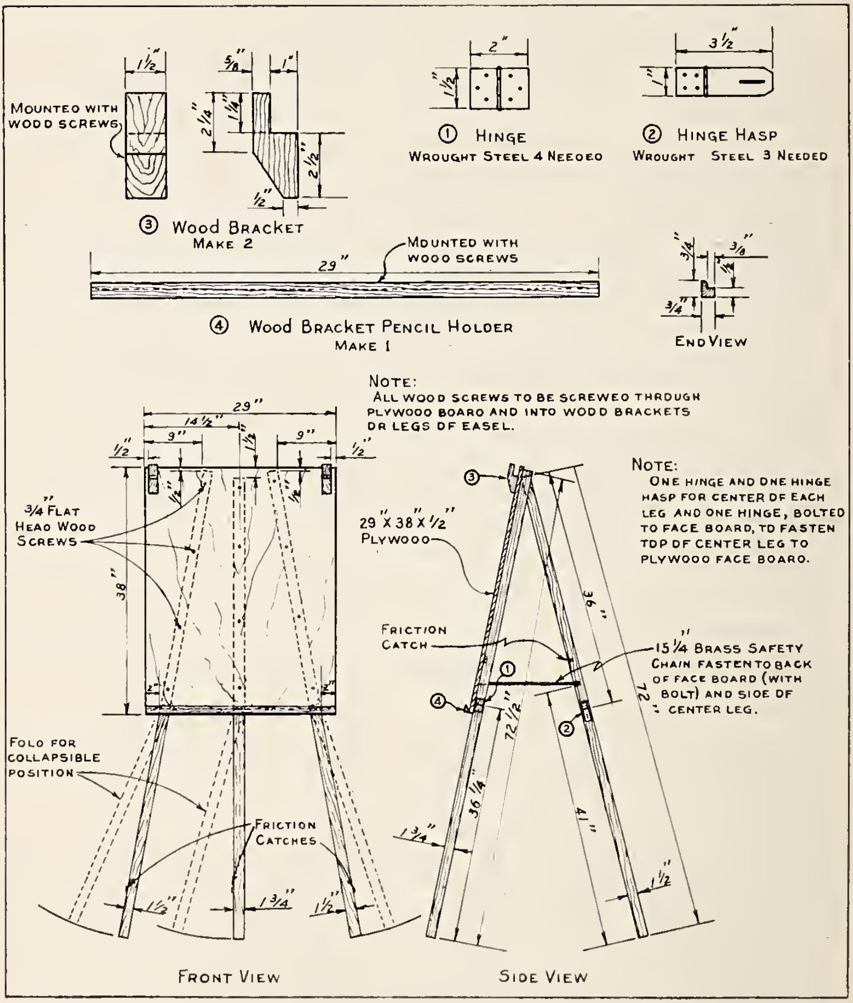
Mounted with wood screws
1½"
5/8"
1"
2¼"
1¼"
2½"
½"
③ Wood Bracket
Make 2
2"
1½"
① Hinge
Wrought Steel 4 Needed
3½"
1"
② Hinge Hasp
Wrought Steel 3 Needed
29"
Mounted with wood screws
④ Wood Bracket Pencil Holder
Make 1
3/4"
3/8"
1/4"
3/4"
End View
Note:
All wood screws to be screwed through plywood board and into wood brackets or legs of easel.
29"
14½"
9"
9"
½"
½"
1½"
3/4" Flat Head Wood Screws
38"
2"
29" x 38" x ½" Plywood
Friction Catch
Note:
One hinge and one hinge hasp for center of each leg and one hinge, bolted to face board, to fasten top of center leg to plywood face board.
36"
15¼" Brass Safety Chain fasten to back of face board (with bolt) and side of center leg.
72"
72½"
36¼"
41"
1¾"
1½"
Fold for collapsible position
Friction Catches
1½"
1¾"
1½"
Front View
Side View

Figure 1.—Portable field easel.

of project personnel we have used easels right on the jobs. The easels available have usually been heavy, cumbersome structures that were hard to carry, especially when the training sites were some distance off roads.

In order to get an easel that was easy to carry, light and compact, yet rigid enough for field use, we designed one using 3-ply plywood as the backboard (fig. 1). The legs were made of 2x2-inch pine hinged where they extend away from the plyboard so they fold up to make a compact unit for transporting. Ordinary 1½-inch hinges were used on one side of the break in the 2x2-inch material with 3½-inch hasps on the reverse side. By setting the hasps so they fit very tightly no additional reinforcements of the legs are necessary. Friction catches hold the legs in place when folded back. A strip of molding serves as a pencil and chalk rail.

The materials necessary to construct such an easel are:

1 piece plywood, 29 by 38 inches
18¼ linear feet, 2x2-inch pine
1 piece molding, 29 inches
2 wood brackets
screws
3 hasps, 3½-inch
4 hinges, 1½-inch
3 friction catches
1 piece chain

This Region has a number of such easels in use and they are proving mighty convenient. They cost about $10 each to construct, including labor. The approximate weight is 19 pounds.

Copies of the diagram are available from U. S. Forest Service, Ogden, Utah.

## Published Material of Interest to Fire Control Men

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*Forest Fire Insurance in Norway,* by Julius Nygaard, Jour. Forestry, May 1951.

*I Am a Smoke Jumper,* by Bob Dolan, Mark Trail Magazine, Spring 1951.

*Release of Sand Pine Seed after Fire,* by Robert W. Cooper, Jour. Forestry, May 1951.

*Scythette—the Motorized Scythe,* Farm Implement News, May 25, 1951.

*The* 1950 *Forest Fire Record* [of the National Park Service], by L. F. Cook, National Park Magazine, Jan./March 1951.

*Use of Fire in Land Clearing,* by Arnold, Burcham, Fenner and Grah, California Agriculture, April and May 1951.

*Use of Plane in Fire Patrol,* by A. E. France, West Virginia Conservation, May 1951.

*We Jump Into Fire,* by Starr Jenkins, Saturday Evening Post, April 28, 1951.

*Western Forestry and Conservation Proceedings of* 1950 *Meeting,* contains articles on slash disposal, fire weather, snag problems, fire records, fire plans for logging areas, radio communication, mobile pumps, chemical fire extinguishers and fire problems of western state foresters, published by Western Forest and Conservation Association, Portland, Oreg.

# COOPERATIVE FOREST FIRE CONTROL IN PENNSYLVANIA

C. L. Kinney, *Resource Management Staff Assistant, Allegheny National Forest,* and A. H. Vogler, *District Forester, Pennsylvania Department of Forests and Waters*

Pennsylvania was one of the first States to provide a State-wide system of fire protection for all its land. Under an act of its General Assembly in 1915 a fire control organization was assembled and trained, and since then it has expanded and improved until today it is one of the best in the country.

This organization is directed by the Chief Fire Warden in the Bureau of Forests, Department of Forests and Waters, at the State Capitol in Harrisburg. Line of authority is from Chief Forest Fire Warden to the State regional foresters (five in number) and thence to the man on the ground, the district forester. By State law the district forester is responsible for forest fire control on *all* land within his district whether it be delinquent land, game land, private estate, or national forest. He has a complete fire control organization: lookouts, inspectors (guards), wardens, cooperators, dispatcher, with the necessary tools and equipment.

Allegheny National Forest was established in 1923. Although the three quarters of a million acres of land within the new national forest was already protected from fire under the State law, it was agreed early that the United States Forest Service would be responsible for fire control. The reason was twofold: The Forest Service would thereby assume a fair share of the costs, and members of its staff would become familiar with the over-all fire control work.

The result was a hybrid Forest Service fire control organization dependent upon the State for part of the detection and dispatching, and for all of the labor. By law the Chief Forest Fire Warden was still responsible for the protection of the national forest, but by mutual agreement the Forest Service assumed responsibility for all its fires. This cooperative arrangement grew and functioned fairly well without benefit of written instructions. However, a series of misunderstandings occasionally resulted in a larger than average fire.

Two years ago the Chief Forest Fire Warden and the Forest Supervisor decided that a memorandum of agreement was long overdue, and on May 12, 1949, they signed such an agreement. A summary of the more important points follows.

1. The Allegheny Fire Protection Boundary is the property line except that all private land of 100 acres or less entirely surrounded by national-forest land, or lying between national-forest land and a natural barrier, is included in the protection boundary.

2. The Forest Service is responsible for the suppression of all fires inside the boundary and the State is responsible for all fires outside the boundary.

3. Each unit is responsible for suppression costs within its area except that the State pays labor costs on fires suppressed by the Forest Service on private land within the protective boundary.

4. Time of yearlong personnel is freely exchanged by the two organizations.

5. All fire wardens and crews are State-appointed but are on immediate call when needed by the Forest Service. Some crews are equipped with State-owned fire tools, some with Forest Service tools, and some with a part of their tool complement from each source.

6. Prevention plans are integrated so that there is no duplication or omission in movie, literature, and poster display.

7. Wardens are trained jointly by the two organizations.

8. The Forest Service reports to the State, on a State fire report form, all fires occurring within the protective boundary.

Of perhaps more importance than the points just summarized is the fact that the top-level agreement permits district foresters and district rangers to enter into written agreement on reporting and dispatching. This leads to greater efficiency because these men are closer to the multitudinous details that are complicated by an over-lapping of the districts of the two organizations.

Detection service is furnished by five lookouts owned and manned by the Forest Service, four by the State, and one financed jointly by the State and the Bradford Oil Producers Association. Three other State lookouts just outside the national-forest boundary also supply detection service. All towers are equipped with radio, and the State has two frequency channels neither of which are the same as that allotted to the forest. Reporting and dispatching are done by national-forest ranger districts.

A new officer in either the State or Federal service has much to learn in short order, but two things are immediately apparent to him. The first is that he has literally twice as much trained overhead as a fire control unit normally carries; and secondly, the arrangement works.

## Are Snags a Fire Problem?

For many years fire fighters have singled out snags as troublemakers. A recent study of nearly 12,000 fires in the national forests of Region 1 indicates that the fear of snags is warranted. More forest fires start in snags than in any other fuel component. More than 34 percent of all fires in Region 1 originate in snags. On the other hand, less than 10 percent of the fires start in green tree tops. Obviously green trees generally outnumber snags in northern Rocky Mountain forests. But in spite of this numerical superiority snags hold over a 3-to-1 edge as a breeding ground of fires. The study showed that the highest percentage of snag fires occur in the grand fir type, with the white pine and subalpine types in second and third positions, respectively. The smallest percentage of snag fires occur in the ponderosa pine type.—DIVISION OF FIRE RESEARCH, *Northern Rocky Mountain Forest and Range Experiment Station.*

# FOOD POISONING IN FIRE CAMPS

Jack E. Handy

*Staff Assistant, Fire Control, Wenatchee National Forest*

No one thing can disrupt the organization on a large fire more than to have the fire fighters all become sick after eating a meal in a fire camp. The most often used explanation is that soap was responsible for these outbreaks. This is seldom the true cause.

Lloyd C. Ajax of the Chelan County Department of Health is one of our best fire cooperators and has worked in many of our fire camps. After helping out on several fires, he wrote us a letter on what he considered to be the causes of sickness in fire camps. The contents of the letter are considered of sufficient value to all persons interested in fire control to be quoted here.

"While working in the fire camp at Hovey Creek it was called to my attention, by several officials of the Forest Service, that outbreaks of diarrhea were experienced in nearly every fire camp organized this year. These outbreaks were generally attributed to soap on dishes. This assumption was probably wrong, since single service paper eating utensils were used in at least one of these camps. Soap is often blamed for such outbreaks, but usually the real cause is food poisoning by contaminated and improperly stored food.

"Food poisoning may be produced in three general ways. The first is what is known as *food infection,* and is caused by eating food containing bacteria which cause illness after growing and multiplying following ingestion. There are several kinds of bacteria which may be the causative organism.

"The second type is known as *food intoxication,* and is caused by eating foods containing toxins produced by contaminating bacteria which grow in the food. The difference here is, that the illness is caused by the toxin rather than the bacteria. The staphylococcus bacteria, common in colds, sinus infections, and infected sores, is the most common causative agent. These bacteria will produce dangerous amounts of toxin in many foods in as little as 5 hours, if temperature conditions are favorable. After the toxin is produced, it is not destroyed by ordinary cooking or boiling, and remember, the toxin is what causes the trouble. The symptoms of food intoxication usually appear within 1 to 6 hours after eating food containing these toxins. Botulinus belongs in this classification but has entirely different characteristics.

"The third type is *chemical poisoning,* due to contamination of food by poisonous chemicals such as insect powders or from certain metallic utensils. It is important to know that the presence of these causative agents do not necessarily change the appearance or smell of food.

"To prevent food poisoning outbreaks, it is necessary to purchase sanitary food from reliable sources, see that it is handled by clean food handlers in a sanitary manner, and store all perishable foods at a temperature below 50° F. Bacteria do not multiply or produce toxins rapidly below this temperature.

"From what I have seen of your fire camps, I would make the following suggestions to improve the sanitation and lessen the possibility of sickness in camp:

1. Be sure of a safe water supply.

2. Replace the cooking utensils having open, hard to clean, seams. Food remains in these seams and serves as a 'seed' for bacterial contamination.

3. Sanitize all eating and cooking utensils after washing, with water above 170° F., or use a warm (not hot) water rinse containing 1 tablespoonful of clorox or similar chlorine solution per gallon. Do not dry dishes with a towel. (Paper utensils are a simpler solution, when available.) The purpose of sanitizing eating utensils is to prevent the spread of communicable diseases.

4. Store utensils in a clean place and keep them covered.

5. Refrigeration—All perishable foods, such as potato salad, mayonnaise, prepared sliced meats, and all other meats and foods containing eggs and milk should be stored at 50° F., or less. Sandwiches containing these foods should not be without refrigeration for more than 5 hours. It would seem advisable to me to have a portable mechanical refrigerator for use at base camps where quantities of food must be kept for some time. This will save food as well as prevent sickness.

6. Storage of food—Keep all foods covered and protected from dust and flies.

7. Cleanliness of employees—Do not have any food handlers working who have a communicable disease or infected sores. See that only food handlers dish up food. Provide clean aprons and cloths for food handlers (it is easy for clothes to become contaminated with intestinal or other bacteria in a rapidly constructed camp). Provide separate hand washing facilities, including soap and sanitary towels, for food handlers, and see that they are used.

8. Camp sanitation—Take care of all wastes, garbage and sewage, to prevent the attraction of flies and rodents.

"In concluding, I would like to say that the general sanitation, other than food handling in these rapidly constructed camps, is very good. The food handling problem in a camp is always more difficult than in a permanent kitchen because of lack of proper equipment, location, and the fact that many camp cooks are not aware of the way food poisoning and diseases are spread.

"The danger of food poisoning is no greater now than in the past, but since we now know the cause and ways of preventing food poisoning, there is no reason to tolerate it. A man affected by food poisoning is worthless as a fire fighter for several hours or days."

# MONTANA RURAL FIRE FIGHTERS SERVICE

George W. Gustafson

*State Coordinator, Montana Extension Service*

Prior to 1942 there was no plan for rural fire control for farm, range, and forest lands outside of organized fire protection districts. On February 11, 1942, the United States Secretary of Agriculture issued a memorandum assigning certain wartime responsibilities to State and Federal agencies, including that of organizing rural America for defense against destructive fires. Implemented by this memorandum, the State Board of Forestry sponsored a State-wide meeting in May 1942 to consider a rural fire control plan for the State. The Governor served as ex-officio chairman of the meeting and representatives of 14 Federal and State agencies were present.

The "Montana Forest Fire Fighters Service" was organized as a result of this meeting, an executive committee was elected, and a State coordinator employed. In the spring of 1945 the name of the organization was changed to the "Montana Rural Fire Fighters Service," dropping the word "Forest," because its primary function is protection from fire not only of forest but also of farm and range land.

The Montana Rural Fire Fighters Service is a voluntary organization maintained through the efforts and interests of the following agencies and associations:

U. S. Army
U. S. Department of Agriculture Council
U. S. Indian Service
U. S. Bureau of Land Management
U. S. Forest Service
Soil Conservation Service
National Park Service
Production and Marketing Administration
Farmers Home Administration
Montana Rural Electrification Assn.
Montana County Commissioner Assn.
Montana State Highway Patrol
Montana State Board of Forestry
Montana State Highway Department
Montana Fish and Game Department
Federal Bureau of Investigation
Private Timber Protective Agencies
Montana Extension Service
Montana Flying Farmers and Ranchers Association

Montana Rural Electrification Association and Montana Flying Farmers and Ranchers Association were added during the past year.

State coordinator is George W. Gustafson of the Montana Extension Service, reappointed to serve his fourth year in that capacity, devoting one-half of his time to the work of the Montana Rural Fire Fighters Service and one-half to the duties of the position of county agent supervisor with the Extension Service.

The State has been divided into twelve fire control districts. A district coordinator is appointed in each district to promote and coordinate all fire control efforts and to develop a program of fire control with the help and cooperation of all agencies concerned within his district.

Through the efforts of the Montana Rural Fire Fighters Service an act to provide protection and conservation of range and farm resources was passed by the 1945 Legislature. This act provides for rural fire protection and control under authority of boards of county commissioners. Each board may appoint county and district rural fire chiefs, organize rural fire control crews, appropriate funds from the general fund of the county, levy a tax, or enter into cooperative agreements for fire control. The boards are authorized to fix closed season when burning is prohibited except through permits issued by the fire chiefs. This law is permissive rather than mandatory.

The board of county commissioners and the county organization form the basis on which the work of fire protection and control must be carried on. An effective organization and fire control program depends on the cooperation of all agencies interested in and capable of contributing to it.

The success of the Montana Rural Fire Fighters Service can best be measured on the county level, and much has been accomplished in fire prevention and control since the organization came into being, as indicated in the following summary of rural fire prevention and control activities in Montana, 1947-50:

| | | 1947 | 1948 | 1949 | 1950 |
|---|---|---|---|---|---|
| Counties organized under State law | number | 53 | 53 | 53 | 54 |
| Meetings held by county fire boards | do. | 31 | 22 | 20 | 20 |
| Members on county fire boards | do. | 449 | 300 | 254 | 199 |
| County and district fire chiefs appointed | do. | 1,072 | 861 | 1,260 | 1,063 |
| Public meetings held | do. | 49 | 49 | 62 | 105 |
| Attendance at public meetings | do. | 2,045 | 1,158 | 1.913 | 2,319 |
| County closed fire seasons declared | do. | 17 | 13 | 23 | 20 |
| State and Federal agencies giving local representative cooperation | do. | 17 | 18 | 16 | 16 |
| Amount of rural fire control budget set up by boards of county commissioners | dollars | 16,544 | 16,411 | 17,585 | 21,600 |
| Rural fires: | | | | | |
| Units burned | number | 293 | 280 | 385 | 160 |
| Estimate of loss | dollars | 382,931 | 560,493 | 987,950 | 390,830 |
| Volunteer fire fighters | number | 2,025 | 2,144 | 4,190 | 1,248 |
| Estimated saving | dollars | 523,280 | 599,500 | 605,635 | 231,200 |

Every county, except two, has provided fire protection under the authority vested in the board of county commissioners by the Rural Fire Control Law. County fire chiefs and district fire chiefs within the county have been appointed. Large sums of money have been invested in fire fighting tools and equipment. Local fire fighting crews have been organized and trained in methods of fire fighting. Closed fire seasons have been established during seasons of dangerous fire hazards. In 1950, 453 volunteers attended 17 county training schools.

A system of reporting all rural fires has been in use for 4 years. District rural fire chiefs report to county fire chiefs or county extension agents. These in turn send the reports to the State coordinator, who makes monthly and annual summaries for the State. These reports give nature of fires, causes, losses, number of volunteer fire fighters, and estimated savings effected through work of fire fighting crews and use of tools and equipment. The summaries are published monthly in the "Rural Fire Flashes."

Voluntary fire control boards or committees are organized in most of the counties to plan fire control programs and advise with the boards of county commissioners on the needs of the counties on fire prevention and suppression. These committees usually consist of representatives of State and Federal agencies having range or forested areas within the counties, members of boards of county commissioners, county fire chiefs, district chiefs, county extension agents, and others interested in fire prevention and suppression on the range, in crops, and in the forest. The following program for rural fire prevention and control to be followed in Montana has been set up:

- I. An active fire control committee, which should be part of the county planning committee.
  - A. Membership to consist of:
    - 1. Member of planning committee.
    - 2. One or more members of the board of county commissioners.
    - 3. County fire chief.
    - 4. One or more district rural fire chiefs.
    - 5. Representatives of the Federal and State agencies in the county.
  - B. Meeting to be held in winter or early spring to plan season's program and agree on division of responsibilities on part of all cooperating agencies.
- II. Prevention measures.
  - A. Inform all farmers and ranchers of fire prevention program.
  - B. Place posters and signs warning of fire dangers and hazards.
  - C. Request individual farmers and ranchers to check premises seasonally.
  - D. Use press, radio, and news letters for publicity.
  - E. Secure cooperation of railroads for safeguards against fires.
  - F. Work with State Highway Department.
  - G. Determine where to place emphasis this year.
- III. Reporting.
  - A. All fires in the county are reported to county agents or fire chiefs.
  - B. County reports all fires to State coordinator.
- IV. Training schools and demonstrations.
  - A. Discussions (Moving pictures can be used to depict one or more of the following points).
    - 1. Rural fire control under present legislation.
    - 2. County organization.
    - 3. The place of the volunteer.
    - 4. Communications.
    - 5. Organization in the fire line.
    - 6. Fire fighting techniques.
    - 7. Equipment and its uses.
  - B. Field work in use of tools and equipment and organization of crews, and a fire suppression demonstration.

Representatives of State and Federal agencies responsible for administration of State and Federal lands have given most valuable support to the fire control program. The Extension Service has accepted the responsibility of carrying on an educational program of fire control, and has assumed leadership in planning the work. Fire control is one of the projects or activities of the county extension programs in all counties. In cooperation with the volunteer county fire control committees, plans are developed early each year, and the fire control program to be carried on in each of the counties and the goals are determined.

## "Missouri Wash": A New Degreasing Preparation

Richard "Dick" Chatham, chief foreman of Stockton Equipment Depot, Stockton, Calif., has developed a degreasing preparation (or cleaning solution) nicknamed "Missouri Wash." The preparation is particularly effective for removing oil or other greasy substances that collect dust and grime on engines and other parts of tractors, motor graders, and other vehicles.

"Missouri Wash" was developed primarily to remove preservative paint from Army equipment prior to repair work. The preservative paint (Army Specification AXS-673-P1), a black, tarlike substance, presented an uncommonly difficult problem of removal. Special commercial cleaners proved only partially effective, and were prohibitive in cost and a menace to health because of strong chemicals and toxic vapors. The degreasing preparation "Missouri Wash" proved satisfactory and also offered an economical and safe means of cleaning engines and other parts subject to collection of oily grime. Less cleaning material and labor are required to do the job. Health menace and fire hazard are reduced to safe limits, due to practically nonharmful ingredients and high flash (fire) point of the solvent.

The use of "Missouri Wash" requires the same precautions governing the use of plain solvents. It should not be sprayed unless ventilation is plentiful, and should never be applied to a hot engine.

"Missouri Wash" is composed of Stoddard Solvent and common corn starch. The solvent is a natural dissolvent agent for oil or asphaltic base substances, but is quite fluid and evaporates rapidly. The corn starch serves as a holding agent and evaporation retarder, thus increasing the inherent dissolvent action of the solvent. Corn starch may ordinarily be purchased from wholesale grocers in 100-pound containers for about 8 cents a pound.

Instructions for preparation and application of "Missouri Wash" are as follows: Add corn starch to Stoddard Solvent in a proportion of 3 to 6 pounds to 1 gallon, depending upon consistency desired. Stir to mix. A thick consistency is desirable for vertical or overhead surfaces, or when surfaces to be cleaned are heavily coated; a thinner consistency for spraying, or when substance to be removed is loose and dissolves readily. Apply with brush or spray as a saturating solution, not as a wash, and in the least quantity necessary. Let soak for 20 to 30 minutes, depending upon conditions encountered, then wash with hot or cold water, or steam. (Steam damages paint and should be resorted to only in extremely difficult cleaning operations.) In some instances, a repeat process will be necessary. If water or steam is not available, use straight solvent to wash off the dissolved material.

Mix only in sufficient quantity for daily use, and preferably, only in quantity for immediate use. The corn starch has a tendency to precipitate and solidify at the bottom of the container unless solution is frequently stirred. "Missouri Wash" will not harm permanent type paints.

"Missouri Wash" should be the answer to the common and difficult equipment cleaning problems which continually face the field. Application for patent is pending. However, "Missouri Wash" may be used by the Forest Service and other government agencies which may choose to do so.—LESTER K. GARDNER, *Administrative Assistant, Division of Engineering, Region* 5, *U. S. Forest Service.*

# PORTABLE HEADLIGHT UNIT FOR TRACTORS

Orville Lind

*Assistant Ranger, Allegheny National Forest*

A handy portable-headlight unit for tractors and bulldozers not equipped with regular headlights can be assembled from a discarded truck head lamp and a home-made universal mounting bracket (fig. 1). The headlight used is a pre-1940 type, the kind not built into the truck's fender. Its glass, reflector, rim, case, and wiring circuit must be in good condition. The positive lead wire should be long enough to reach the positive battery terminal or the live side of the ignition system; the negative side is grounded to the tractor frame by means of the universal bracket. This system will not work with tractors having magnetos.

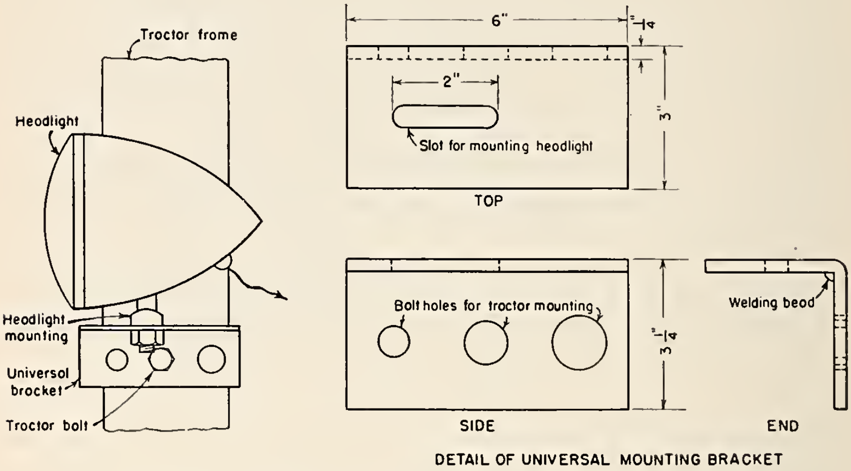

Figure 1.—Assembly of portable headlight unit for tractors.

The light can be quickly attached to the front of the tractor frame by means of a universal mounting bracket. This bracket is made of ¼-inch iron plate, 6 by 6¼ inches, or from ¼-inch angle iron, 3 by 3¼ by 6 inches. If ¼-inch iron plate is used, bend to the dimensions of the ¼-inch angle iron. On one end of the 3- by 6-inch face, make a 2-inch slot slightly larger than the diameter of the headlight mounting bolt. On the 3¼- by 6-inch face, drill two or three bolt holes of different diameters so that one will fit the bolt of any tractor on which the unit may be used. The angle of the bracket should be reinforced by a welding bead. Slight variations may be necessary in the mounting bracket so that it will fit the type tractor on which the light is to be used. The bracket can be made for a right- or left-hand unit.

Paint the light fire red and attach it to the mounting bracket slot by means of the headlight bolt. Bolt the bracket to the frame and attach the positive lead wire to the positive battery terminal for a check on wiring and lighting.

This portable tractor headlight was developed to meet a special need of the Allegheny National Forest. Here, lease tractors can usually be rented more quickly and cheaply than Forest Service tractors can be transported to a fire. Because the rented equipment often lacks adequate lights for night work, each district fire cache has a box of four portable headlights ready for use. In addition to the lights, the box contains wrenches, friction tape, and extra light wire.

### Flammability of Chaparral Depends on How It Grows

Southern California chaparral has long been noted for its flammability, which is usually ascribed to the general character of the vegetation, steep slopes, and severe weather conditions. Probably not enough emphasis has been given to changes in the vegetation itself that affect its fuel qualities.

All evergreen California chaparral species normally grow new twigs and leaves in the spring and drop a portion of the older leaves in the summer and fall. For the canopy to reach full development, after this type of vegetation is first established, usually requires 8 to 12 years, during which time little dead wood or litter is produced and fire presents no particular problem.

When the site becomes fully occupied, annual production of new twigs and leaves is balanced by the death of older branches and leaves. In normal years there is a seasonal cycle in flammability caused by an increase in numbers of leaves with high moisture content in the spring, then a decrease in numbers and a decline in leaf moisture in summer and fall. Normally, this annual cycle of balanced growth and death causes a gradual build-up of dead fuels. But flammability is usually kept within reasonable, though seasonally variable, limits by the slow compacting and decay of accumulated litter, and by the overstory of green leaves which shields against sun, wind, and desiccation.

This normal state of affairs has been upset since 1945—the beginning of the present southern California drought. By 1948 the shortage of rainfall began showing its effects by the appearance of individual dead bushes scattered over the landscape.

By the beginning of the 1950 fire season the topsoil was powder dry. In some areas there was little if any growth of new leaves; more old leaves, too, had fallen. Instead of full-bodied dense crowns, thin, transparent, drab-colored foliage met the eye. By midsummer the chaparral looked and felt parched. That it could be so dry and still be alive was unbelievable. The canopy over large areas was punctured with stark, dead branches, and many more than the usual number of dead shrubs could be seen.

This marked change in growth—or lack of it—meant a much higher than normal ratio of dead to green fuel, extremely flammable foliage, higher fuel temperatures from increased exposure to the sun, more freedom of air movement—meaning more wind close to the ground.

Years of drought are often characterized by low humidities and high temperatures. These occurred often in the summer of 1950. The lack of moisture in soil and vegetation also held the pickup of humidity and fuel moisture at night to a minimum, resulting in extra long daily burning periods.

The combination of deteriorated cover and severe weather had by 1950 reached the point of near-maximum conflagration potential. By May this year the southern part of the State had received only half or less of its normal seasonal rainfall; very little more is expected. The outlook for the 1951 southern California fire season is thus for more thinning and dying out of shrubs with a consequent increase in flammability beyond anything yet experienced in our time.—CHARLES C. BUCK, *Division of Fire Research, California Forest and Range Experiment Station.*

# COLLAPSIBLE FIRE CAMP TABLE SUITABLE FOR DROPPING FROM AN AIRPLANE

R. Boyd Leonard

*Fire Control Officer, Salmon National Forest*

The collapsible table plan shown in the January 1951 issue of Fire Control Notes inspired the personnel of the Salmon National Forest to study ways of breaking the table on down into a parcel small enough for dropping from a plane of the Ford Tri-motor type and one that could be packed easily on a pack horse. It was generally believed that these could be dropped with a supply order and would materially improve the facilities in the early stages of a fire camp. They could also be used at camps accessible by motor vehicle.

The table that was built is compact and light. It has no parts that are not fixed securely. Material used is ¾-inch plywood, strap hinges, door hinges with removable pin, a few feet of light chain, and some screws.

In figure 1 the braces can be seen mortised into keepers on the bottom side of the table. The chains are fixed at both ends and work automatically. The lower shelf board slides into place and the two parts of the door hinge are fastened securely together with the pin. Figure 2 shows door hinge with pin in place and the two braces removed from the keepers and in place to give rigidity to the table. The two lengths of chain are now tight and held that way by the braces.

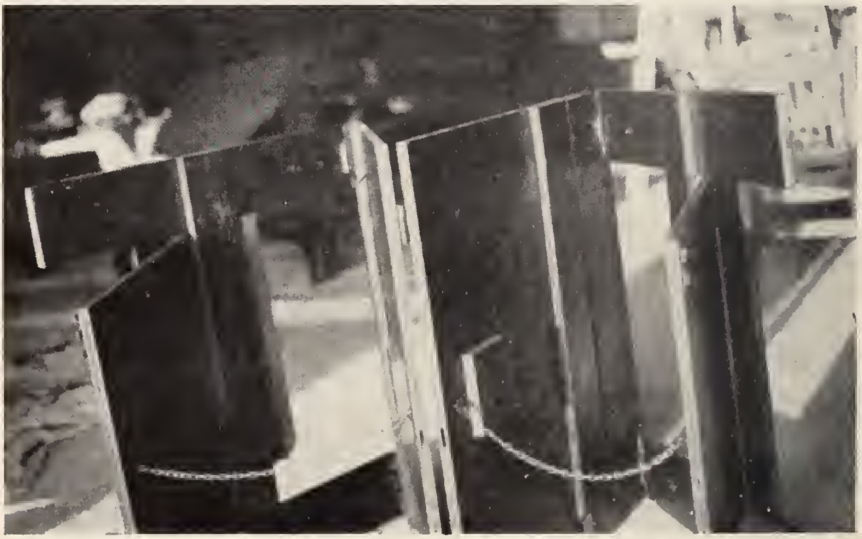

Figure 1.—Collapsible table partly opened. Note location of braces when table is folded.

When the table is in use the strap hinges are necessarily on top (fig. 3). These could be turned over and mortised into the top to lie flat with the surface. For a camp table, however, the hinges as shown will likely not prove objectionable and it is believed that they give more strength against twisting or sudden blows.

It is planned to give the table a thorough try before reporting on the success of this development.

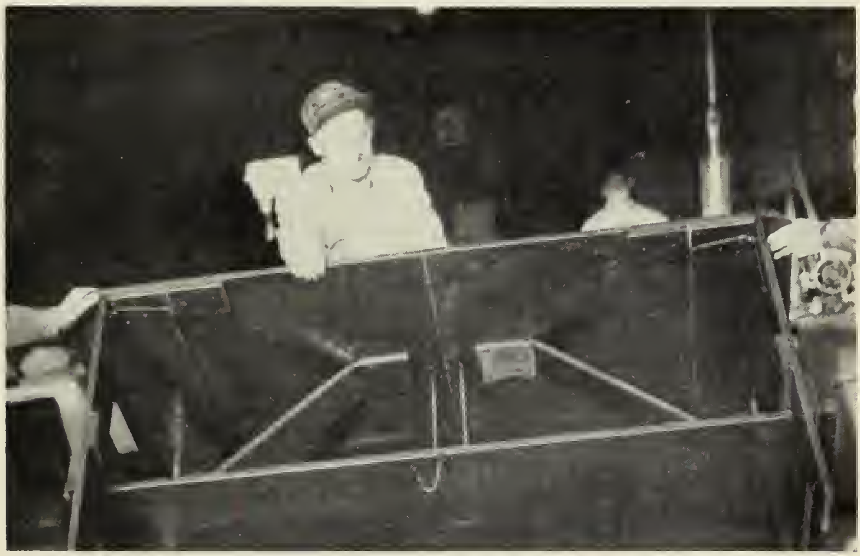

FIGURE 2.—Table assembled with door hinge pins and braces in place.

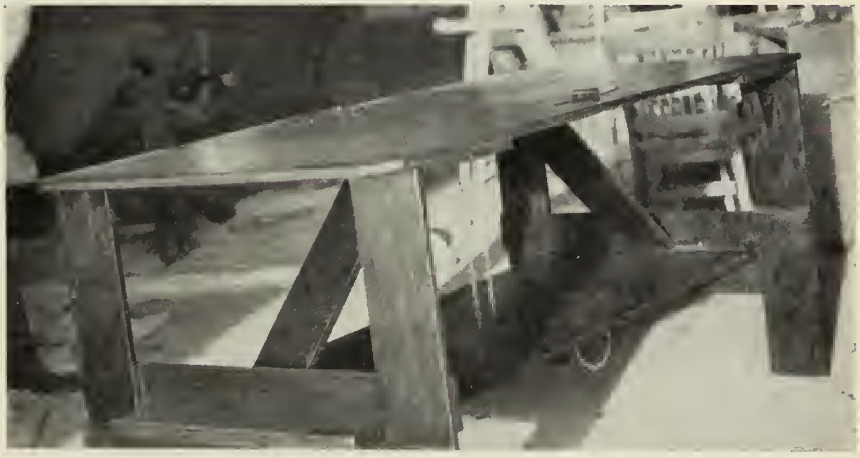

FIGURE 3.—Fire camp table ready for use.

# BUTANE-DIESEL FLAME THROWER

ARCADIA EQUIPMENT DEVELOPMENT CENTER

*California Region, U. S. Forest Service*

An article, "A New Mobile Flame Thrower," by Henry Wertz, Jr., and C. Vernon May, of Los Angeles County Department of Foresters and Fire Wardens, appeared in the October 1946 issue of FIRE CONTROL NOTES. The unit described was a trailer-mounted power flame thrower, using butane and Diesel for fuel.

This unit has proved very successful in backfiring under adverse burning conditions. Such conditions have a tendency of developing rapidly in coastal areas, because of fog rolling in from the ocean.

To meet the increasing demand for these backfiring units, three trailer units were built in 1950 at the U. S. Forest Service Equipment Service Shops at Arcadia, from existing blueprints and information supplied by Los Angeles County Department of Foresters and Fire Wardens, and with recommended features for better performance and safety added. Most of the necessary information for designing the revised unit, which has been proved safe and efficient, was provided by the personnel of Los Angeles County who were responsible for the original development.

This flame thrower is designed to project a very hot flame for a considerable distance. This is accomplished by using a cheap but safe fuel, Diesel oil, which is ignited by passing through a butane flame. The ignited Diesel is projected 30 feet or more by means of compressed air (fig. 1); some Diesel fuel is deposited on the ground to maintain a flame. The primary purpose of the butane is to produce a sure-fire ignitor for the Diesel fuel.

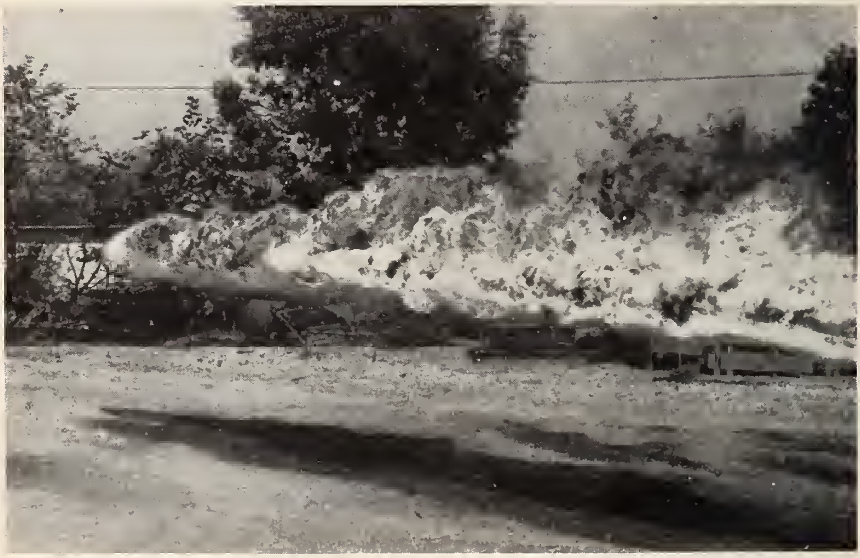

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FIGURE 1.—Flame projected by the butane-Diesel flame thrower.

However, butane alone produces a flame which carries 3 or 4 feet, and is very effective for igniting light forest cover.

The unit is mounted in a sturdy trailer with a wide wheel base and a low center of gravity (fig. 2). The tongue of the trailer is equipped with two hitches, one for secure and safe trailing behind a truck on the highway, and the other for pulling behind a tractor.

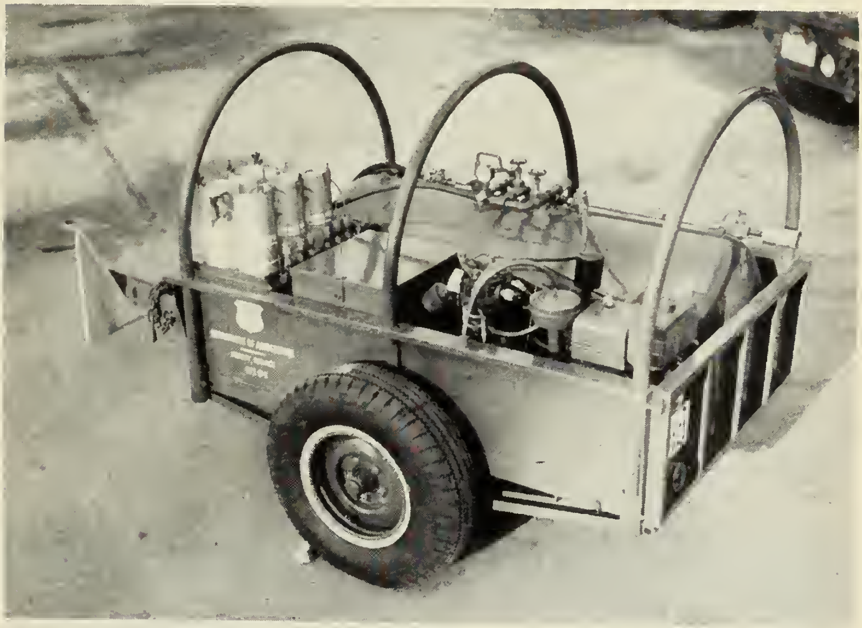

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Figure 2.—Backfiring unit mounted in trailer.

Three "crash bars" are installed over the trailer to protect equipment in case of an upset. Experience in the past has revealed the necessity of such protection.

The revised unit has a 120-gallon tank in which approximately 100 gallons of Diesel is placed, to allow room for compressed air. Near the center and at the top of the Diesel tank are five holes to serve as inlets and outlets for fuel and air. One has an internal dip pipe extending down to within one-half inch of the bottom of the tank, serving as a discharge line for Diesel. At the top of this pipe is attached a hose for supplying Diesel for the firing gun.

A second hole takes a pipe, tapping the air space at the top of the tank, which is also connected to the Diesel line and equipped with a valve so that the hose and gun can be purged of fuel by an air stream. As a safety precaution, a pop-off valve that opens at 150 pounds pressure is installed in this line.

A third hole, near the fill spout, takes a valve which serves as an escape for the compressed air. The handle of this valve projects over the fill spout so that the cap cannot be removed until the valve is opened.

The fourth hole serves as a fill spout, and the fifth as an intake for air from the compressor

The six small butane tanks fit into a rack and are securely fastened in place. They can be replaced when empty without interrupting operation, as only two are in use at a time. Six copper tube lines connect them into a manifold, with six valves located adjacent to the manifold. These valves permit closing of any number of the six lines for replacement of the butane tanks, or isolation of any leak or break. A regulator and gage are installed on the manifold outlet to control butane pressure to the firing gun.

A compressor, run by a 5.1 horsepower engine, supplies the compressed air to the space in the top of the Diesel tank. An adjustable pressure relief valve installed in the bypass line allows setting to any pressure desired. (For Diesel fuel the best operating pressure for ignition and projection was found to be 80 to 110 pounds.)

Two 50-foot lengths of three-ply oil-resistant hose connect the fuel tanks with the firing gun. This heavy hose is deemed advisable as a factor of safety.

The gun is 5½ feet long, made of ¾-inch pipe, with a special built brass firing nozzle (fig. 3). Flow of butane is regulated by a globe valve installed near the handle. From this valve, copper tubing extends to the tip, fastened along the pipe, for delivering butane to the firing nozzle. Guns designed for the first units had a quick-throw valve mounted near the tip and regulated by a remote control wire to a trigger on the handle. This caused the gun to be front heavy, so in the later design the quick-throw valve is mounted on the handle.

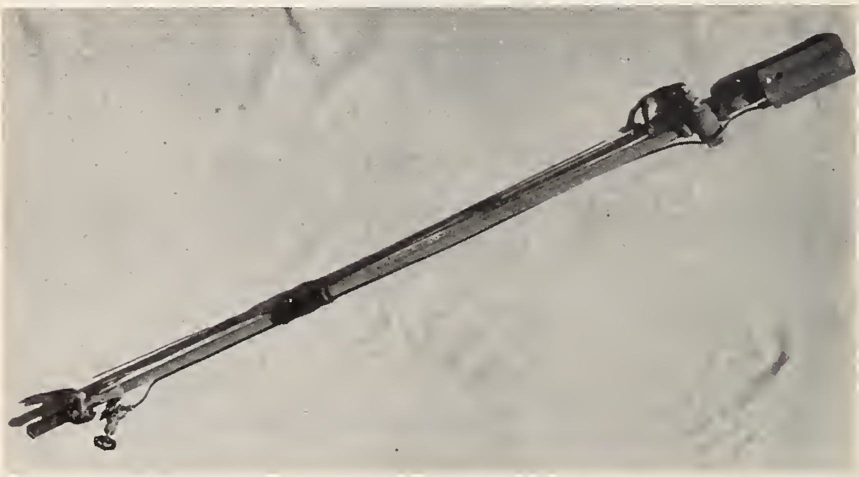

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Figure 3.—Firing gun of the butane-Diesel flame thrower.

A check valve installed at the tip traps the Diesel in the barrel when pressure is shut off. Even after making this change the gun is heavy for continued use by one operator, but, because of excessive heat, operators will of necessity change off frequently.

The ⅜-inch hose and 5/32-inch tip use 4.8 gallons of Diesel per minute, and 21 minutes of continuous firing is obtained from one tank of Diesel

(100 gallons). With the very hot flame and long projection of the flame, continuous firing would be rare. However, this might occur when backfiring along a road, in which case additional fuel could easily be supplied. It is feasible to use a ⅛-inch tip and ¼-inch hose, which would increase operation time without refueling, and still maintain good flame projection.

Since this trailer unit is designed primarily for towing behind a tractor, its capacity and weight have been increased considerably over those of the original models built in 1946. The additional capacity of the fuel tank provides longer operation without refueling. Weight is so distributed in the trailer that the front end is heavy, but is still sufficiently light for one man to attach the trailer hitch. Cost of the unit complete with trailer in March 1951 was $1,400.

Further details and specifications are available in drawings F-26-01 to 04, at the Arcadia Equipment Development Center, U. S. Forest Service, 701 N. Santa Anita Ave., Arcadia, Calif.

## World-Wide Distribution

FIRE CONTROL NOTES, with less than 5,000 copies of each issue, probably sets some kind of a record for wide distribution. About half of each issue goes to Forest Service personnel. Other Federal and State agencies having fire control responsibilities also receive it regularly, as do many privately financed fire control organizations.

The larger libraries maintain complete files of the NOTES. Forestry schools, corporations, timberland owners, consulting foresters, and other interested companies and individuals receive it.

Canada leads all other countries in the number of copies distributed outside of the United States. Copies are sent to individuals or agencies in 70 different foreign countries—from South Africa to West Australia, from Burma to Iceland.—E. ARNOLD HANSON, *Information Specialist, Division of Information and Education, U. S. Forest Service.*

# A SLIP-ON ATTACK UNIT

Einar E. Aamodt

*Engineer, Region 9, U. S. Forest Service*

A 1-ton, 4-wheel-drive pickup has been equipped at Michigan's Roscommon Shop for fire fighting with a slip-on tanker, slip-on pump, and slip-on hydraulically controlled plow. Special 9:00x13:00 tires provide flotation and good traction. Road clearance is 8½ inches. A special heavy-duty 15-gallon gasoline tank is installed on the right running board. Two overload long spring leaves are added on each side in front. Heavy, 2x½-inch angle iron armor is used on the sides, running boards, and fenders; heavy 5-inch channel bumpers are provided front and rear. Two back-pack pumps are mounted in the rear of the fenders, and a flame torch on the heavy-duty gas tank (fig. 1). These can easily and quickly be replaced or removed, and are well protected from damage by brush and trees. Hand tools are carried in the large tool box under the front seat cushion. Two tow hooks on the front frame, and a ball hitch on the rear are provided. There is room for two single seats in the rear of the truck. The wide cab seat can accommodate three persons.

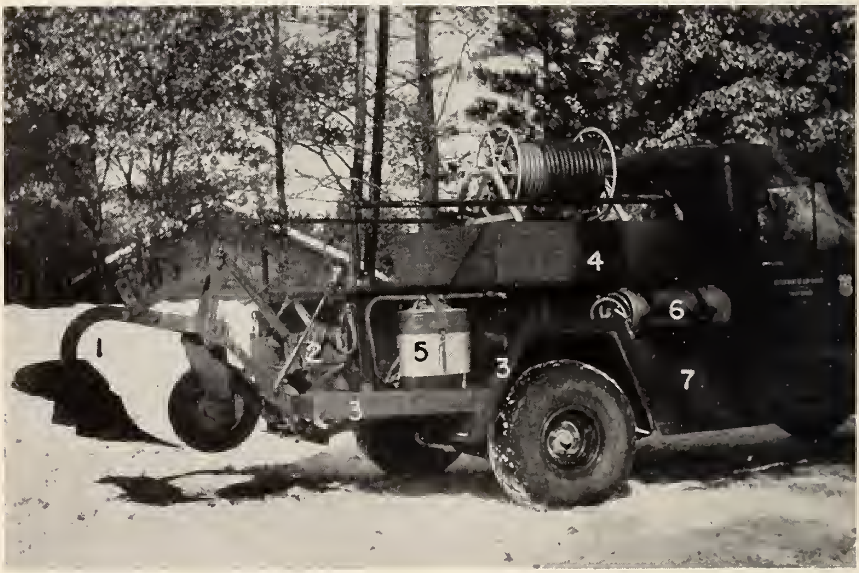

Figure 1.—Pickup equipped as a fire fighting unit: (1) Plow; (2) hydraulic lift (pump not shown); (3) bumper and fender armor; (4) water tank (245 gallons) with live hose reel; (5) back-pack pump (one each side); (6) backfiring torch (under body flange); (7) special heavy-duty gas tank.

The 245-gallon water tank used is 48 by 48 by 26 inches high. The tank is equipped with 6-inch rollers and can be easily rolled onto a platform when filled with water. It is held securely in place by two ¾-inch slide pins in the front of the body, and an easily removed ½-inch bar across rear of tank, fastened through each side of the pickup body. A live hose reel, with Chickson joint and 300 feet of ¾-inch hose is mounted on the tank. Hose connection from the pump to the reel and the 1½-inch hose connection to the tank are the quick pull type and can be easily and quickly engaged or disengaged.

The slip-on plow is a modified Monroe hydraulic plow. It is easily removed from the three-point carrier by pulling three pins. The plow lever and level float arms are also removed by pulling pins. The hydraulic cylinder unit is mounted on a single steel plate, along with the pump, and this entire assembly can be removed by pulling two hand pins. A double hose break-away no-leak coupling is installed in the hydraulic hose line and can be coupled or uncoupled without tools and without loss of any oil, and this can be done with or without pressure on the oil line.

The new style large-size modified Jeep plow with high lift, has the hydraulic control levers on the steering column. The plow operates on a level float arrangement and does not require adjustment when the water load is decreased. When the plow has been raised as far as it will go the pressure valve whistles indicating that the lever should then be moved to the neutral position. When the plow is down in plowing position the control lever can be put in neutral position and left there, allowing the plow to float without any down pressure. Pressure, if needed, can be applied to the plow by leaving the control lever in the down position. A button screw arrangement on the oil reservoir valve provides adjustment to increase or decrease the pressure to the plow. Full maximum pressure of 500 pounds per square inch in the hydraulic system is obtained when the button is all the way in. Each half turn clockwise reduces the pressure about 85 pounds per square inch. Once the desirable pressure point is found, the adjustment is left there until soil conditions change.

The hydraulic pump is mounted on top of the engine head and is powered by a V-belt drive. A slip pin makes it easy to disconnect the pulley drive and disengage the pump. The pump should be disengaged on long trips and when the plow is removed.

When the plow is raised upright (in carrying position) it cannot be operated. The trailer hitch may be used when the plow is upright.

The modified Willys plow, which is the same as the modified Jeep plow except for the greater width of the turf knives, makes a fire line approximately 60 inches wide, with furrow bottom width of 20 to 21 inches and depth of 3½ to 4 inches. Most plowing is done with the plow in floating position, without pressure from the hydraulic pump.

The pump slip-on unit is mounted with a hydraulic cylinder (plow) unit, on a ½-inch mild steel plate (fig. 2). This entire assembly can be easily removed by pulling two hand pins which extend through the reinforced floor of the truck. The pump is chain drive, 3 speeds, from the rear power take-off. A ⅝-inch pitch roller chain drive is used. A short shaft with a universal joint and sprocket drive is mounted along-side of and parallel to the hydraulic cylinder unit. A short channel bumper bar is bolted in place in the center of the rear bumper, giving full protection to the power take-off when the truck is put to other use.

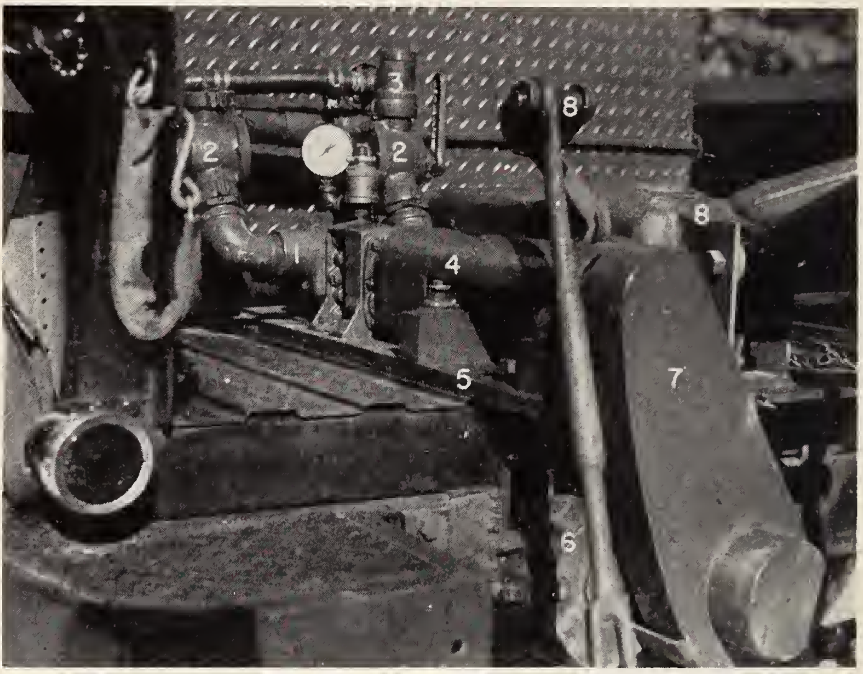

Figure 2.—Pump slip-on unit: (1) pump; (2) siamese valve; (3) automatic pressure valve; (4) drive shaft cover; (5) plate on which pump and hydraulic lift mechanism is mounted (fastened to bed of truck by 2 pins); (6) power take-off for lift mechanism; (7) roller chain drive cover; (8) lift mechanism.

Two valves, with handles pointing in the direction of the flow of water, and a pressure release valve that feeds the excess water back into the pump, are used in the pump unit. A cap is provided so that the unit can be operated as a stationary pumper using 1½-inch hose, and a second cap allows attachment of a suction hose. A slotted forestry type hose connection is provided between the tank and pump, and a 14-inch length of rubber suction hose is used to absorb vibration between the pump and tank. The tank outlet is equipped with a 1½-inch gate valve so the water can be contained when the pump unit is removed.

Adequate pump speed was determined for the lowest forward speed (low-low), and more than enough water is provided. When used as a stationary pumper the pump can be run at three different gear shift speeds (low-low, intermediate-low, and high-low), so the engine can be run at a relatively low speed while the pump operates at a high speed. The pump will deliver 50 gallons per minute free flow and 23.7 gallons per minute at 150 pounds per square inch pressure. Flow can be reduced with small nozzle to 3 gallons per minute at 200 pounds pressure, with the excess water bypassed back to the pump. The pistol grip type gun used with this unit has an easily operated single trigger control with locking device that gives complete quick shutoff to fog, spray cone, or straight stream. Five sizes of nozzles are provided to give a choice for light or heavy (slash) fuels, the largest size being ¼ inch or 20 gallons per minute and the smallest 3/32 inch or 5 gallons per minute. Control of fog, any width of cone spray, or straight stream of water is excellent, regardless of size tip used. No wrenches are required to change tips, and extra tips can be carried in a clip on the gun.

The slip-on unit can be removed or replaced without the use of any special tools or equipment and a complete change-over would ordinarily take less than 10 minutes.

The hydraulic plow lift and power take-off pump controls in the cab do not interfere with the normal operation of the truck when the plow and pump units are removed. The manipulation of the controls with the plow or pump removed causes no damage. The heavy armor of the fenders and sides and the front and rear bumpers does not interfere in any way with the normal use of the truck. It gives added protection for year-round use. A post-hole digger or other power belt attachments can be used with the hydraulic unit with or without the water tank or pump in place. The plow can be easily removed and a tree scalper or other attachment installed quickly.

Net weight of all equipment and full water load is 3,005 pounds; net weight of truck is 3,235 pounds; drawbar draft power for S-low gear (1 to 6 m.p.h.) is 3,240 pounds; drawbar required for plow is 800 to 1,200 pounds on the average. Five horsepower is required for pump at 150 pounds pressure.

The 1-ton unit handles the larger plow easily and most times without effort. Passengers riding in the cab usually cannot tell whether the plow is up or down. Tests indicate safe speeds, fully loaded, of 50 m.p.h. on highways, 40 m.p.h., on gravel roads, 25 m.p.h. on side roads and ways, and 6 to 15 m.p.h. in open field travel. Climb ability in grass sod and brush extends to 50-percent slope, and plowing to 32-percent slope. These tests were made with the 9:00x13:00 tires at 26 pounds pressure.

This truck with the new "F" head engine and flotation tires, and its all-steel cab, wide comfortable seat, good visibility, inside and outside rear-view mirrors, and heater and defroster, has a utility value for off-the-road and cross-country use in winter as well as in summer that is not equalled in any other unit. The truck rides comfortably, handles easily, and is reasonably economical to operate.

The rear channel bumper extends to the lower end of the rear fender, and has a piece of floor plate flush with the top of the bumper extending in to the body of the truck. This serves as a step plate and also as a mounting for the back-pack pump as well as affording protection and extra strength. The center portion of the bumper is removable to accommodate the plow unit. The bumper extends about 8 inches in the rear of the truck body to give protection while backing up. A brush guard is provided on the front end and 1-inch pipes extend from the outer ends of the front bumper to the ends of the front fender armor.

The tank is constructed of 16-gauge mild steel four-way floor plate and has angle-iron reinforcements in all corners and one set of baffle plates run each way. Inside of tank is treated to prevent rust. Top cover is fastened with brass screws and can be removed to recoat or clean tank. The factory mounted gasoline tank was so low that debris and stumps damaged it, and there was also danger of puncture while on fire line. It was replaced by a special heavy-duty tank.

The larger tires and wheels appear to be a good investment if the truck is to be used for plowing and for extensive cross-country travel.

## Rain That Does Not Affect Fires

Rain during the fire season is a blessing, but a blessing whose magnitude can easily be overestimated. Many a smokechaser has become soaked while traveling through open country and thereby lulled into a false sense of security, only to be rudely awakened by the enthusiastic behavior of a fire which apparently hadn't heard about the rain. The reason is that quite a lot of our precipitation never reaches the ground.

Data presented by Joseph Kittredge in his book "Forest Influences" show that the forest types of the northern Rocky Mountains intercept 8 to 43 percent of the total precipitation during the growing season. Interception varies inversely as the amount of precipitation in each storm. Showers of up to 0.04 inch may be completely intercepted by an unbroken forest canopy, while 55 to 75 percent of a 0.20-inch rain will probably reach the ground.

The importance of interception to fire control in Region 1 becomes apparent from analysis of precipitation per shower during July and August 1950. During this exceptionally wet summer, 26 percent of all showers brought 0.01 inch of rain or less, 47 percent 0.05 inch or less, 60 percent 0.10 or less. Thus it appears that about one shower in every three produces too little rain to reach the fuels beneath a heavy canopy. Indications are that perhaps another third of the summer storms do not get enough rain through the canopy to moisten fuels significantly.

Thus after a summer rain the normal order of fire behavior will usually be reversed for a time, with fires in green timber more active than those in burns and logged-off areas. And at such times the behavior of fires in the timber has a good chance of surprising firegoers, dispatchers, and unwary overhead.—DIVISION OF FIRE RESEARCH, *Northern Rocky Mountain Forest and Range Experiment Station.*

# BLANKET BAGGER

### LEON R. THOMAS

*Supervisor, Mendocino National Forest*

A simply, efficient labor- and time-saving device for placing blankets in standard 10-blanket paper bags has been developed by Warehouseman Russell Burton of the Sequoia National Forest.

The device consists of a table 30 inches high with a top 26 by 24 inches and an angled bag holder 24 by 48 inches with a foot board (fig. 1). An old tatum is attached to the angle board so that the top lifts up and permits the paper sack to be clamped in the tatum jaws. The top is then turned down inside the bag and the blankets slide over it without pulling out the bag.

A piece of strip metal is attached to the table and part of an old clamp board is fastened to the top of the strip. This holds the upper part of the paper bag. The clamp on the metal strip is 1 foot from the table.

One man with the bagger can operate faster and more efficiently than two men without it.

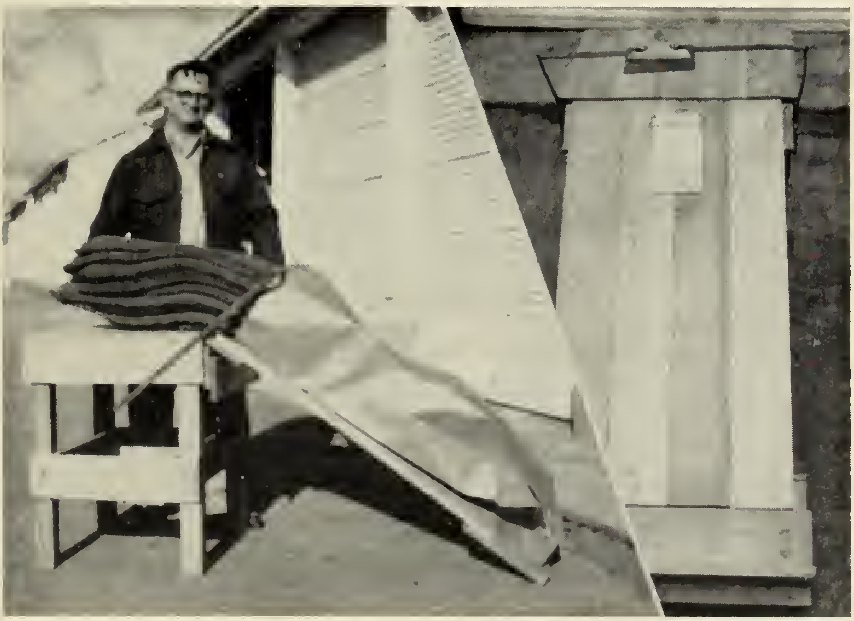

FIGURE 1.—Blanket bagger: *Left,* Warehouseman Burton operating bagger; *Right,* arrangement of tatum and metal strip with clamp.

# FROZEN PREPARED MEALS

LEON R. THOMAS

*Supervisor, Mendocino National Forest*

Complete prepared frozen meals, as now extensively used by the commercial continental and intercontinental airlines and branches of the armed forces, are well adapted to many Forest Service activities.

The basic meals consist of meat or fish, potatoes or rice, and a vegetable, placed in an aluminum or tinfoil plate and covered with a sheet of foil then quick frozen. Some companies pack the basic meal with bread, butter, a drink, salad and dessert, and disposable eating utensils to make a complete one meal unit. Other companies just pack the basic meal and the latter items must be added to round out the meal. Breakfast units are similarly prepared and packaged. They consist of eggs with bacon or ham, fruit and variable items.

The Sequoia National Forest experimented in the use of sixteen different individual types of meals during the summer of 1950. They were used in such activities as feeding men in fire camps and on the fire line to week long pack trips in the "back country." The results were very good in all cases. The types found most suitable to our needs were the basic plates of chopped beef, beef stew, pot roasts, swiss steak, roast turkey, chicken, and the egg and bacon breakfasts.

The meals must be handled and cared for in the same manner as all quick frozen products now carried in nearly all grocery stores. Dri-ice refrigeration can be used for transporting the meals and for packaging in sealed cartons for later use under field storage conditions.

Methods of heating the meals offer no complications. Almost any type heat can be used such as kitchen stoves (ovens or on top), gas field range or oven, open fire, covered campground stove or ice can stove, on top of and buried in a bed of coals, or special stoves distributed by the frozen food companies.

A few important advantages of the meals are:

1. Sanitary. They are packed under strict supervision and the bacteria count is very low. They do not spoil quickly after thawing. There is no chance for contamination until the cover is removed for actual eating.

2. Excellent quality and good quantity. The meals are of excellent quality and taste. Only the best of raw products are used. There are 11 ounces or more of eatable food in each basic meal. This, supplemented with bread, drink, salad, and dessert, is sufficient for the average man. For those who may want more, a few extra meals can be put in and divided up.

3. No waste. All of the food is eatable. There is no waste in preparation and little of the prepared food will be wasted.

4. No cooks needed. Professional cooks are not needed. Most anyone can heat the meals after a little experience.

5. Ease of handling. The units are light in weight, compact, and very easy to handle and store.

6. Nothing to retrieve. Everything is disposable—nothing to wash, nothing to retrieve. This is a most important factor in on-the-line use and in back country fires.

7. Stored for immediate needs. The meals are always ready—no cooking preparation needed. They can be transported where desired and made ready to eat in a minimum of time.

8. Less cost. Frozen meals can be purchased, stored, and made ready for use cheaper than meals prepared in present conventional fire camp methods.

9. Saving of manpower behind the line. Fewer men needed in service and camp jobs.

10. Delivered hot if desirable. The meals can be heated in a base camp and delivered to the line preheated, where transportation methods permit.

11. Keeps men on the line. The convenience and ease of handling makes it much more possible to keep men on the line, *where they are needed,* by serving them with frozen prepared meals by helicopter, cargo plane, truck, or mule train.

The meals are recommended for use in all types of administrative operations requiring road crews, construction crews, established camps, and the like. They are particularly recommended for use on the fire lines and in small fire camps where it is desirable that men *stay on the line.* They are excellently adapted for delivery by parachute and by helicopter.

Several forests in Region 5 are planning to use frozen prepared meals this year. Caution is urged in undertaking their use for the first time. New techniques and procedures are required. It is suggested you learn these before undertaking a large scale project.

Reference to companies supplying the frozen meals can be found in various frozen food journals, or secured from the Operation Division, U. S. Forest Service, 630 Sansome Street, San Francisco 11, Calif.

# USE OF AIRCRAFT FOR FOREST FIRE DETECTION IN WEST VIRGINIA

A. E. France

*Pilot, West Virginia Conservation Commission*

The Conservation Commission of West Virginia has used an airplane in forest fire detection for the past 3 years. During this period the airplane has been flown more than one thousand hours. Six hundred and fifty hours was flown on fire patrol; the remainder was used for executive transportation, beaver dam survey, deer census, aerial photography, patrolling closed streams, and in fire control demonstrations for school children, 4-H Clubs, and Boy Scouts. In this 3-year period West Virginia had 3,498 forest fires reported. Of this number about 700 fires were reported by the pilot, making an average of more than one fire per hour flown.

On days of low visibility observation from towers is restricted to a few miles. Under such conditions the airplane patrols the area between the towers to give complete coverage. Visibility on many of our areas is poor because of smoke from many industrial plants and burning slag piles. When no wind is blowing a haze develops in the valleys and extends upward above the fire towers. The airplane can fly above this haze and spot fires that tower observers cannot possibly see.

A good example of this occurred one day in November 1948. There had been no wind for 24 hours and it was very hazy in the southern counties, making detection of fires by the towers difficult. While on patrol that afternoon the pilot spotted nine fires which would normally have been observed by the towermen.

There are times when a tower has a reading on a fire but is unable to get a cross-check from another tower. In some cases a smoke will drift a few miles in the hollow before rising. This makes it difficult for the towerman to give the exact location of the fire. The airplane is then used to locate the fire and help the suppression crew or smokechaser get to it without too much delay. Sometimes the smoke is from a legal burning, a condition which often cannot be determined from a tower. If this is the case, a determination from the air can save the forest protector a needless trip. Also, if the smoke happens to be from another source, such as brush burning or right-of-way burning, the forest protector can be notified and he can change his plan of action to suit the situation.

The airplane is very helpful in determining the size of a fire. While over the fire the pilot can relay information to the station or suppression crew concerning the terrain and whether the fire is burning slow or fast. He can also advise if it is possible to get to the fire by truck, car, or jeep, and if there are any barriers, such as pipe-line rights-of-way, strip mines, or streams, which may help in suppression of the fire.

A system of triangulation similar to that used by the fire towers has proved effective in giving a more exact location of fires. Briefly, this is done by flying a compass heading from two known towns or locations, and at the point where the two lines intersect is the location of the fire. Best results come from a fix from two points that will give a 90° angle.

These uses indicate the value of the airplane in fire detection, but there are some disadvantages. It is difficult to locate fires accurately after dark, and flying single engine airplanes at night in mountainous terrain is not safe practice. A second disadvantage is that the airplane cannot safely be flown on days when the wind velocity is high. Both of these disadvantages could be partially eliminated with a small twin engine airplane but as yet there has not been an airplane built to meet this need.

Periods of high wind velocity are not frequent. We experienced extremely high winds for one 9-hour period on March 27, 1950. That day, we had 191 fires reported. These fires burned over twenty thousand acres in the 9-hour period. At 11:00 o'clock the pilot took off on fire patrol with a wind blowing from the south at about 20 miles per hour. By 12:10 the pilot had reported 14 fires in 2 counties and the air had become so turbulent that he could hardly hold his map, much less run an accurate fix on the fire. When he landed, the wind was gusting to 55 miles per hour. Later, weather stations recorded wind velocities as high as 72 m.p.h.

The West Virginia Commission's Stinson airplane is equipped with a radio and public address loud-speaker that is very effective from an altitude of 2,000 feet. This speaker is mounted in the right rear seat where a 12-inch diameter hole has been cut to emit the signal. The hole can also be used for aerial photography and for dropping of small parcels by parachute. It takes about 10 minutes to install or remove this speaker. With the speaker, the plane can carry three passengers. When the speaker is removed a plywood board is fixed over the hole and a metal plate is installed under the fuselage to smooth up the airflow.

Power output of the public address speaker is 50 watts, which is plenty without too much drain on the battery (fig. 1). Speeches should be short and well planned to cut down the drain on the battery and because time is limited over the area due to the speaker being mounted vertically in the airplane. Some speakers are mounted at an angle so that the address can be centered over one spot while the airplane circles the area. Both systems are good. With the vertical type best results can be obtained by flying upwind at reduced power and speed with flaps down. This gives a longer period over the area and the signal is forced downward by the flaps.

The speaker has been very effective in the control of brush burning. When a farmer is burning his brush too near the forest the pilot can warn him of the danger, and he usually puts the fire out. On many occasions the pilot gives locations of fires to local protectors when the county forest protector is engaged with other fires in his county. Another use of the loud-speaker is to give directions on going fires, especially when they are larger than usual and in rugged terrain.

The airplane also has a two-way radio operating on a frequency of 31.98 megacycles (figs. 2 and 3). This radio, designed for the Greyhound Bus Company, was purchased because it worked on a 12-volt system as does the airplane. The heavy base plates were removed and replaced by aluminum to lighten its weight considerably.

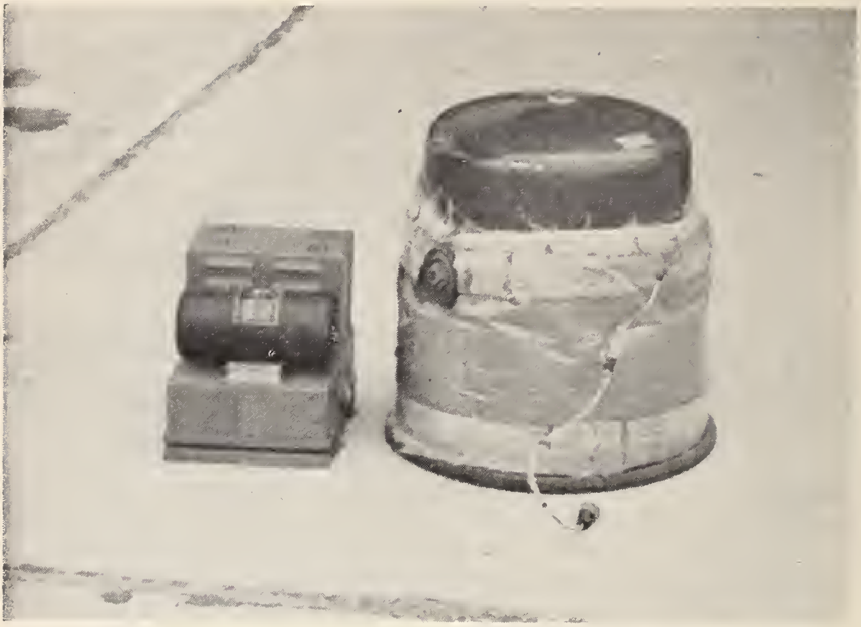

FIGURE 1.—Loud-speaker and 50-watt power supply.

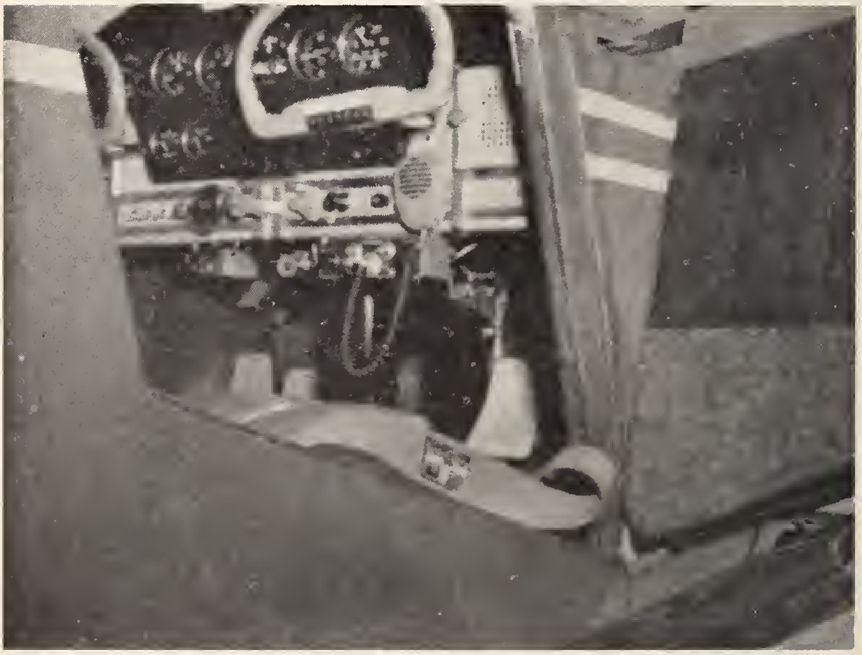

FIGURE 2.—Control head and microphone for FM radio mounted on instrument panel.

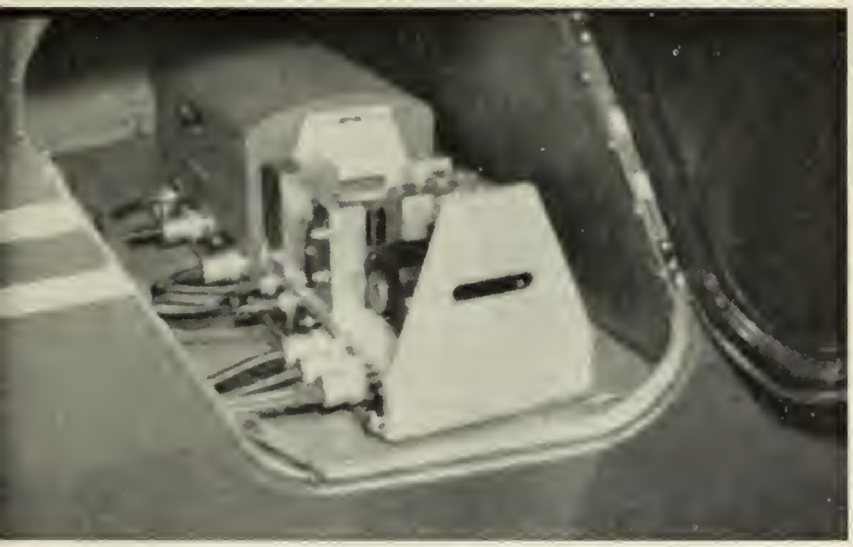

FIGURE 3.—FM radio installed in baggage compartment of airplane.

This radio provides the pilot communication with 154 other radio units. Of these units 110 are mobile, 5 are at district headquarters, and the rest are in fire towers.

It is not intended that airplanes will replace fire towers, but they will be used as aids to the towers and for patrolling our Ohio River drainage which is not covered by fire towers. Airplanes will also be used to detect fires during the winter months when the fire towers are not manned and the weather becomes mild enough for forest fires. The past two winters were very mild in West Virginia, and we had a number of fires in the southern counties. Covering this large area was quite a task for our one airplane.

It has been very difficult to determine the cost per fire for aerial detection. The Commission's airplane has cost about 5 dollars per hour to operate. This includes gas, oil, and maintenance. Hangar rent is not included because this is given to the State by the Kanawha County Court, which owns and operates the airport. The pilot does most of the maintenance, except major overhauls and relicensing of plane each year. The only way we have determined the cost per fire spotted is by adding the number of fires and illegal brush burnings reported and dividing this total into the cost of operation of the airplane.

The area covered by the airplane is also hard to determine for a number of reasons. If the pilot flies at an altitude of 6,000 or 7,000 feet above the terrain and the visibility is fair to good, he can spot a fire in a radius of 20 to 25 miles. Under these conditions and at a speed of 110 m.p.h., the airplane can cover a large area in an hour's time. Flying at higher altitudes is impractical because much of the time is spent climbing and descending to run fixes on the fires and to use the loud-speaker. Also the pilot has to be at a low altitude to help the radio car or truck find the fire, and to report road conditions and any other information which may help in suppressing the fire.

The number of fires in a day's patrol also has a great deal to do with the amount of coverage. On days when many smokes are being seen the area covered is materially reduced because some time has to be devoted to each fire. For example, on one day of patrolling with a large number of smokes to investigate, the pilot covered 10 counties in 6 hours as compared to 25 counties in 6 hours on another day when only three fires were seen. The amount of coverage per hour can be increased by using a faster plane, which can still fly slow enough to use a loud-speaker efficiently, and also by the pilot becoming better acquainted with the area patrolled, thereby cutting down the time for running fixes.

Determining the coverage is still a problem for which we would appreciate any information or suggestions. The pilot has tried using a planned patrol. This works all right on days of few or no fires, but does not when a large number of smokes are being seen. More airplanes each covering a smaller area would probably be the answer.

We have only had an airplane on forest fire detection for the past 3 years, but are utilizing it more all the time. Any suggestions as to better or more efficient use of airplanes in this phase of forestry will be welcomed by the Conservation Commission of West Virginia, Division of Forestry, Charleston 5, W. Va.

## Vibration of Plane Struts Dangerous

Fastening loud speakers to airplane wing struts may set up vibration of sufficient intensity to prove dangerous. The tendency of prolonged vibration to cause crystalization of metal is well known and since wing struts are designed in accordance with the capacity of specific metals to withstand tension, any change in a metal which would change its strength might result in failure.

The installation shown in the photograph was test flown by engineers of the C.A.A. and found to vibrate dangerously at all flying speeds, power on and power off.

As an alternative, the speaker was installed inside the fuselage immediately aft of the rear seat. The rim of the speaker is flush with the bottom of the fuselage and set at an angle which points the instrument at a spot on the ground around which the plane is flown while a message is being transmitted. This installation was approved by C.A.A.—O. A. Alderman, *State Forester, Ohio Department of Natural Resources.*

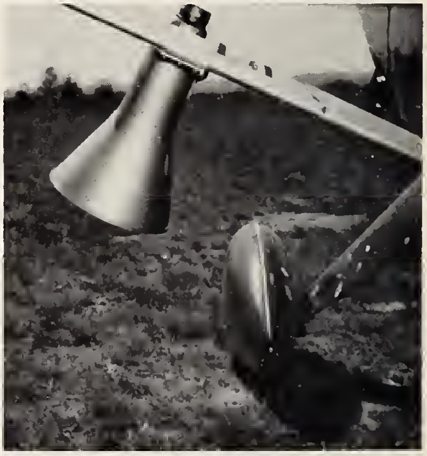

Figure 1.—Loud speaker fastened to wing strut of Stinson 150 Voyager.

## INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed in the manuscript immediately following the paragraph in which the illustration is first mentioned, the legend being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

When Forest Service photographs are submitted, the negative number should be indicated with the legend to aid in later identification of the illustrations. When pictures do not carry Forest Service numbers, the source of the picture should be given, so that the negative may be located if it is desired.

India ink line drawings will reproduce properly, but no prints (black-line prints or blueprints) will give clear reproduction. Please therefore submit well-drawn tracings instead of prints.